

CLASS 415, ROTARY KINETIC FLUID MOTORS OR PUMPS

SECTION I - CLASS DEFINITION

This is the class for apparatus, and corresponding methods of operating such apparatus, comprising a runner*, and in which a working fluid* is guided to, around, or from, the runner.

A means for guiding or confining (e.g., casing*, distributing means*, etc.), the working fluid* must be present, at least by implication, in a claim for classification in this class unless specifically indicated otherwise, the mere recitation of the moving member or runner* being insufficient. A reference in a claim to a control or regulating means for the working fluid* is considered to imply the presence of such guiding or confining means. In such an instance, the claim will be classified in this class, despite the lack of an explicit inclusion in the claim of the guiding or confining means for the working fluid*.

This class includes typically turbines, wind and water wheels, centrifugal pumps* and blowers; and such casings*, conduits, guide means and other elements peculiar to the subject matter of this class not otherwise classifiable.

Also included is apparatus of the type described, but which has no shaft to transmit mechanical power output therefrom, unless the sole specific disclosure is for a flow meter of the turbine type, see References To Other Classes, below, for a class reference to measuring and testing.

Also specifically included in this class is a device comprising a container or receptacle supported for orbiting movement and in which (1) a working fluid* flows into and out of the container to cause the orbiting motion or (2) the container is caused to move by a force to retain and raise a supply of working fluid* to a higher relative elevation before the fluid is discharged from the container.

This class will also take a “black box” motor which is clearly shown as rotary unless specifically described as of the expansible chamber type; see Class 418, for such expansible chamber motor.

SECTION II - LINES WITH OTHER CLASSES AND WITHIN THIS CLASS

This class will not take an apparatus of the type described which includes an expansible chamber in which the working fluid* acts, i.e., a chamber which varies in volume by virtue of one wall moving towards or away from another wall. Examples of such devices are the sliding vane*-type rotary devices or the nutating axis-type rotary pump*. See References to Other Classes, below, for such apparatus.

This class will not take a pump of any type whose driving means, no matter how broadly recited, is controlled by a condition of the pumped fluid; see See References to Other Classes, below, Class 417, appropriate subclasses, especially 1+ for such devices.

A “black box” pump clearly disclosed as rotary will be found in Classes 417 and 418; see the respective line notes of these classes.

GENERAL RELATIONSHIP WITH OTHER CLASSES

This class relates to apparatus of the type described usable as a pump* or as a motor* or as both alternatively. It does not theoretically provide for: (1) the combination of a pump* and a motor* driving the pump*, (2) the combination of a motor* and a load driven thereby, or (3) the combination of a motor* and a source of working fluid* or an energy increasing means (e.g., pump*) for the working fluid*.

However, all of the above combinations are common and are frequently mentioned broadly in the claims even though of substantially no significance for search purposes.

Therefore where a motor* or a pump* is so claimed as to afford a basis for classification in this class, the mere nominal recitation in the claim of one of the above common combination features and also a mere nominal recitation of a relationship of such features with the motor* or pump* will not cause exclusion from this class.

(1) NOTE. WHEN THE PUMPS* FORM THE BASIS OF CLASSIFICATION FOR THIS CLASS.

A. The following examples of terminology are considered to be mere nominal recitations of a drive means for the pump* which would not preclude classification in this class:

- (1) drive means, or means for driving;

(2) motor* drive in which the motor* is disclosed as a well known type and identified merely by its generic name or merely as turbine, electric, magnetic, internal combustion, etc.

B. The following examples of terminology are considered to be minimum significant or specific recitations of a drive means for the pump* which would preclude classification in this class and indicate classification in Class 417, Pumps.

1. language reciting enough of the driving structure to identify the type of motor* or to permit or cause cooling, (other than merely mounting the unit in a duct where it would inherently be cooled) lubricating or sealing the motor* elements or the motor* housing, e.g. a. for an electric motor*, the stator and rotor or a specific housing for sealing or cooling; b. for a turbine motor*, the runner* and a fluid distributing means; c. for a reciprocating motor*, the piston and fluid guiding or confining means; d. for a magnetic motor*, the arrangement of the magnets around the rotor; e. for the appropriate motor*, the electric circuit or control therefor, or the fluid circuit or control therefor, including, in the case of a single blade*, part of which is used as the driving turbine and the remainder as the pumping element, the two fluid paths.

2. an art device (door, vehicle part, etc.), recited as the driving means.

3. a common supporting base for the pump* and motor*; the motor* or its housing supported on the pump* housing or vice versa; a motor* mounted on a tank, or a tank mounted on the motor*; details of the motor support*.

(2) **NOTE. WHEN THE MOTOR* FORMS THE BASIS OF CLASSIFICATION FOR THIS CLASS;**

A. The following examples of terminology are considered to be mere nominal recitations of a load driven by the motor* which would not preclude classification in this class: 1. a propeller 2. a rotary or reciprocating fan, pump* or impeller 3. an electric generator 4. indicating means

B. The following examples of terminology are considered to be specific or significant recitations of a load driven by the motor* which would preclude classification in this

class and indicate classification in the class in which the load is classified: 1. a three bladed propeller (Class 416, Fluid Reaction Surfaces, (i.e., Impellers); 2. a centrifugal, positive displacement or gear pump* (Classes 417, Pumps, or 418, Rotary Expansible Chamber Devices); 3. an electric generator in which is included any detail of the generator or any relationship between a generator part and a motor* part (Class 290, Prime-Mover Dynamo Plants); 4. an electric generator in which, as claimed, part of the electricity is used for control purposes and part of power purposes (Class 290, Prime-Mover Dynamo Plants); 5. a dial and needle, number wheels, or other specific meter or register mechanism (Class 73, Measuring and Testing)

C. The following examples of terminology are considered to be nominal recitations of a source or energy level increasing means for the working fluid* for driving the motor* which would not preclude classification in this class: 1. a boiler 2. a flowing fluid stream 3. a rotary or reciprocating fan or pump* 4. a motor* (named) driven fan or pump* 5. a plurality of pumps* in parallel

D. The following examples of terminology are considered to be significant or specific recitations of a source or energy level increasing means for the working fluid* for driving the motor*, which would preclude classification in this class and indicate classification in Class 60, Power Plants: 1. a firetube or watertube boiler 2. a dam or earthworks (nominally or broadly recited) bearing some physical relationship with the motor*; 3. a fan or pump* characterized as to type more specifically than rotary or reciprocating (e.g., centrifugal, positive displacement, pulsator, etc.), or reciting any detail thereof (e.g., piston, lobe, etc.); 4. a motor* driven pump* in which a detail of the motor* is recited and by which the type of motor* can be identified (e.g., combustion chamber, armature, field, turbine rotor and flow means, etc.), or in which a specific motor housing is recited for sealing or cooling motor* elements; 5. a plurality of pumps* in series

E. If what appears to be a load (e.g., pump* or fan) on the motor* is actually disclosed

for internal purposes only to affect a motor* condition or operation, (e.g., lubrication, sealing, control), then the load is considered to be a part of the motor* itself, no matter how specifically it is recited, and would not exclude a claim from this class. If the load output is disclosed for external use only, classification is on the basis of the load in the appropriate class if the claimed recitations of the load warrant. If the load output is divided and part is used internally for affecting a motor* condition or operation, and another part used externally, classification is on the basis of the load.

(3) Note. When a motor*-pump* combination is claimed so broadly so that the recitations applicable to either the pump* or motor* cannot form the basis for classification in this class, the combination is classified in the appropriate pump* class if the motor* drives the pump* or in Class 60, Power Plants, if the pump* is an energy increasing means for the working fluid* for driving the motor*.

PUMP-TANK RELATIONSHIP

The combination of a pump and a tank is generally classified in Class 137. However, a single, nominally recited tank, reservoir, chamber, pump or other similar fluid holding means will be considered as merely a flow line or conduit and will be classified in Class 415. However, see Class 222, Dispensing, class definition, paragraph 91 regarding other pump-tank relationships.

PUMP-ACCUMULATOR RELATIONSHIP

An accumulator or surge damping device is usually connected to a pump inlet or outlet for the purpose of maintaining a smooth flow to or from the pump. When disclosed for the purpose of surge damping or insuring smooth flow, the combination of an accumulator and pump is classified in Class 415.

PUMP-LIQUID ACCUMULATION CONTROL RELATIONSHIP

1. A pump claimed in combination with a liquid accumulation controlled valve is classified in Class 137 except for the following which will be found in Class 415. When the liquid accumulation or level responsive valve which controls a liquid flow to the pump or a gas relief from the

pump is for the specifically disclosed purpose of priming the pump, see Class 415, subclass 24.

2. A pump claimed in combination with a drive transmission therefor which is controlled by liquid accumulation is classified in Class 415, subclasses 24 or 122.1+.

PUMP-PLURAL SERIAL VALVE RELATIONSHIP

A pump claimed in combination with plural serial valves in either or both the inlet and outlet flow path, and without any branched flow path is classifiable in Class 415, even though one or more of the valves is manually operated or condition responsive.

PUMP-MAIN FLOW PATH AND BRANCHED FLOW PATH RELATIONSHIP

Generally a branched flow system having a main flow path and a branched flow path, with or without a pump is classifiable in Class 137. However, several exceptions, which usually depend on the disclosure in the particular case, are set forth below:

1. A pump having plural branched flow paths, whether valved or not, communicating with a single source or receiver is classifiable in Class 415. Where there is no specific disclosure of the sources or receivers for the flow paths, the disclosure will be considered as if there were a single source or receiver and will be classified in Class 415.

2. A pump having a main flow path and a branched flow path, each communicating with separate sources or receivers is classifiable in Class 415, if: (A) The source or receiver for the main flow path is unclaimed or nominally claimed and (B) the branched flow path is specifically disclosed as a relief inlet or outlet to the pump a priming inlet to the pump, a bypass around the pump, or a vent, waste or drain outlet from the pump, and either (i) the main flow path is uncontrolled or (ii) the main flow path is controlled and the branched flow line is (a) uncontrolled, (b) manually controlled or (c) controlled by a condition responsive valve responding to a condition in the main flow path which is sensed between the pump and the main flow path controller.

SECTION III - REFERENCES TO OTHER CLASSES

SEE OR SEARCH CLASS:

60, Power Plants, appropriate subclasses for: (1) the combination of a motor* and a specifically recited source of working fluid* or a means to increase the energy level of a working fluid*, see LINES WITH OTHER CLASSES (2) Note, C and D; (2) plural diverse motors*, each providing power for external use, either in series on the same shaft, or in parallel on separate output shafts; (3) the combination of a pump* (no matter how broadly recited) which discharges to a fluid motor*, where a part of the motor* output is used to drive the pump*, or a fluid motor* driving a pump* which discharges at least part of the fluid to the motor* for driving the motor*; (4)a motor* (even though disclosed as being for Class 415) which depends for operation on the buoyancy of a fluid, or on the vertical component of Tides and Waves; (5) fluid operated reciprocating or oscillating motor* of the nonexpansible chamber type; (6) all fluid operated motors* not otherwise classified, (e.g., "black box" not clearly shown as rotary); (7) the combination of a fluid motor and exhaust fluid treating or handling. Exhaust fluid is considered to be that fluid downstream of a runner* after it leaves the final means which could affect operation of the motor (e.g., by affecting the back pressure on the runner); treatment or handling is considered to involve more than merely carrying away the exhaust fluid from the motor through a single constant diameter conduit. A valve in the outlet conduit affects back pressure on the runner and is proper subject matter for Class 415; an expanding outlet conduit, a specific physical spatial relationship of the exhaust conduit and the motor, or a plurality of outlet conduits are examples of fluid handling for Class 60; a heat exchanger is an example of fluid treatment for Class 60. An elbow, support or other fitting is considered to constitute a mere part of the exhaust conduit, unless the diameter of the conduit is altered thereby, which indicates classification in Class 60. (8) the combination of a specifically recited runner for moving a fluid and a outlet for discharging the fluid, where the sole, specific disclosure is to obtain thrust and therefore translating motion of the apparatus with which the runner and outlet are associated.

73, Measuring and Testing, subclasses 861.79+ for a rotary motor* in which the rotary member drives means which continuously determines, registers or indicates the volume or rate of flow of a fluid material, the motor* being positioned in the flow path of the material, and for a turbine-type meter which, as disclosed, is incapable of acting as a motor*.

(1) Note. In many turbine meters, the runner* shaft extends no further than the bearings therefor. Since no power output may be obtained from such an arrangement, such a meter is incapable of acting as a motor* and classification in Class 73 is indicated.

(2) Note. Class 415 will take a turbine-type meter in which the runner* shaft is disclosed as connected to a nominal load (e.g., indicating mechanism), see Lines With Other Classes, (2) Note, A and B; and the combination of a pump* or motor* for this class and a register or recorder giving information as to the amount of working fluid* passing through the system.

74, Machine Element or Mechanism, subclasses 5+, especially subclasses 5.37, 5.43 and 5.7 for a gyroscope (see Class 74, subclass 5, (1) Note for definition and (2) Note for exception) comprising a mass rotating about a first axis, this axis supported for at least a limited amount of freedom to pivot about a second axis transverse to the first. A claim reciting the combination of a mass and fluent means to impinge on and cause the mass to rotate about an axis is classified in Class 415, unless there is claimed structure which permits freedom of motion of the mass about more than one axis, even though the sole specific disclosure is for a gyroscope mass with motion about two axes.

(1) Note. A rotor which is claimed as spherical and a complementary bearing therefor has been considered as having the two degrees of freedom of motion required for gyroscopes, and accordingly, such a claim is classified in Class 74.

91, Motors: Expansible Chamber Type, appropriate subclasses for a motor which may be of the rotary type but which converts the energy of a simple pressure fluid in an expansible chamber, no energy being extracted except by expansion of the chamber by virtue of the fluid reacting against a fixed abutment, a mechanical force

- being produced by movement of a wall of the chamber.
- (1) Note. Classes 91, Motors: Expansible Chamber Type, 417, Pumps, and 418, Rotary Expansible Chamber Devices, all provide for an expansible chamber device (motor or pump) which may be rotary, the distinction being on the nature of the valving for the working fluid. For clear statements as to the differences among these classes see the line notes in each class to the others.
- 137, Fluid Handling, the line between Classes 137 and 415 is generally that of combination and subcombination, with Class 137 providing for a fluid handling system which may include a pump and Class 415 providing for a rotary non-expansible chamber type pump, per se. However, certain areas of subject matter are considered peculiar to pumps and their operation and are considered to be exceptions to the general rule stated above. These and other lines are set out below.
- 138, Pipes and Tubular Conduits, appropriate subclasses, for a flow conductor of general utility there provided for, with or without a flow restrictor or guide means, even though disclosed for use in a motor* or pump* environment. A housing or casing* which is of peculiar shape (spiral or volute) for coaction with a disclosed motor* or pump* runner*, even though claimed as the casing*, per se, will be classified in Class 415.
- 184, Lubrication Appropriate subclasses, for a pump* forcing lubricant and a bearing member which receives the lubricant.
- 185, Motors: Spring, Weight, or Animal Powered, appropriate subclasses, for a motor* which uses a discrete weight for operation thereof; a fluent material stream flowing into and out of a runner* bucket is considered a discrete weight for Class 185 and such devices will be found therein even though the operation is intermittent, i.e., the runner* stops while the bucket is filled, then rotates to another position where it may again be stopped for emptying the bucket.
- 188, Brakes, subclass 273 and 293 for a rotary member driven by fluid, and driving a fluid, respectively, in a conduit or casing and having a control for the exhaust fluid so that shutting off the exhaust develops a back pressure on the rotary member and thus increases its resistance to rotation.
- 192, Clutches and Power-Stop Control, subclasses .03 through .098 for the combination of a fluid rotary motor* and a clutch mechanism, in which there are interrelated controls for the motor* and the clutch, and subclass 3, for the combination of a fluid rotary motor* and a brake or lock applied to the motor* or its output shaft and having a mechanism for the joint control of the motor* and the brake or lock.
- 198, Conveyors: Power-Driven, appropriate subclasses, particularly 701+ for a member mounted on a driven endless belt or on a driven rotating wheel, the member dipping into a source of fluent material and carrying a portion thereof to another station, the member working in the open or in a loose fitting casing* or having a flange or other means for retaining the material thereon while moving.
- (1) Note. A close fitting casing* around the member is considered to define with the member an expansible chamber device, and, when driven by or driving a fluid, indicates classification in Class 91, Motors: Expansible Chamber Type, Class 92, Expansible Chamber Devices, or Class 418, Rotary Expansible Chamber Devices.
- 222, Dispensing, subclasses 14+, 23+ and 71+ for a pump* with selectively preset means to control the quantity discharged or with totalizing or recording means, or with measuring means in addition to pump* structure: and other appropriate subclasses for the combination of a supply container and a pump* in a dispensing system: see the Main Class Definition of Class 222, section 9 for a complete statement of the line between the two classes.
- 239, Fluid Sprinkling, Spraying, and Diffusing, appropriate subclasses, for a nozzle, per se, which discharges a free jet of fluid and which is of general utility, even though disclosed for use with a fluid operated motor*, and for the combination of a pump* and a specific discharge nozzle; subclasses 240+ for a turbine-type motor* driving a continuously moving fluid distributor or nozzle; Subclasses 251+ for an external fluid supply and a fluid distributor or nozzle which is continuously moved relative to a support by the reaction caused by discharge of the fluid from the distributor or nozzle (e.g., reaction turbine) the fluid being discharged into the ambient atmosphere, in the absence of a disclosure that the moving distributor is aerodynamically shaped or has aerody-

- dynamic qualities, thus making the distributor an impeller properly classified in Class 416, Fluid Reaction Surfaces (i.e., Impellers), the reaction discharge being considered the driving motor* therefor; Subclasses 380+ for the combination of a fluid pump* and a discharge modifier downstream of the pump and external of the fluid confining or guiding means, which modifier is continuously moved by a motion transmitting means or by the fluid discharging thereon from the fluid system outlet.
- (1) Note. A claimed casing* or housing surrounding the moving distributor whereby the discharged fluid is collected indicates classification in Class 415; however, a claimed specific terminal fluid discharge element from the casing* to the atmosphere shifts the claim back to Class 239.
- (2) Note. A set of wheels driven by the moving fluid distributor is considered to be a specific load and is excluded from Class 415. Such devices will be found in various classes, depending on details claimed; for example, wheels on a rotary distributor discharging fluid into the atmosphere will be found in Class 239.
- (3) Note. A disclosure that the direction or rotation of the moving distributor may be alternated indicates classification in Class 415; this feature is entirely foreign to a lawn sprinkler type moving distributor.
- 241, Solid Material Comminution or Disintegration, appropriate subclasses for a pump* and comminuting structure which is separate and distinct from the pump* runner or the surrounding casing* and causes comminution before or after impelling. A device in which the pump* runner* or the surrounding casing* is so made as to cause comminution of the material at substantially the zone of impelling the material is proper subject matter for Class 415; a structure in which the comminuting structure is arranged upstream or downstream of the pump* impeller, which may itself cause comminution, is classified in Class 241.
- 248, Supports, subclasses 637+ for the combination of a support and a casing* claimed so broadly as to be of general utility, even though disclosed as the casing* of a motor* or pump*. Thus, the recitation as a turbine or pump casing* will not serve to exclude the claim from
- Class 248. However, a claim which includes a runner* or a shaft* in the casing* is excluded from Class 248 and will be classified in Class 415 if no other basis for classification exists; a claim which includes the relationship between a support and a part (other than the casing*) of a motor* or pump* device is excluded from Class 248 and will be found in Class 415 unless classified elsewhere on another basis.
- 277, Seal for a Joint or Juncture, for a generic sealing means or process (e.g., seal between a runner* and another relatively movable part, seal between the two relatively moving members, does not recite enough details of the rotary kinetic device, etc.), subclasses 345+ for a seal between relatively movable parts (i.e., a dynamic seal), especially subclasses 427+ for a dynamic close proximity seal (e.g., contactless, fluent, etc.) having an impeller or another rotating member to form a centrifugal liquid barrier.
- 384, Bearings, appropriate subclasses for a bearing which may include a runner or shaft supported formation with on details of the runner or shaft.
- 403, Joints and Connections, appropriate subclasses, for means connecting a plurality of elements, even though the elements be disclosed as pump* or motor* elements, if the rotary device is recited nominally or by name only and cannot form the basis of classification in Class 415.
- 406, Conveyors: Fluid Current, appropriate subclasses for systems which transport solids by means of a fluid current, and which include a fluid pump for generating the current. Rotary pumps, per se, which include structure peculiar to the passage of solids as well as the conveying fluid through the pump are classified in Class 406, subclasses 96+. See also subclasses 57+ and 80 for a screw conveyor or an endless belt conveyor, respectively, which feeds to the inlet of a blower or pump.
- 416, Fluid Reaction Surfaces (i.e., Impellers), appropriate subclasses, for the subcombination of a rotary member having a surface which is acted upon or sets upon a fluid, where the claims are silent in regard to a means for confining or directing a fluid to, from, or around the member, even though such confining means be disclosed; and for the subcombination of an impeller operable by the kinetic energy of a fluid medium, even though disclosed as operated by the potential energy or weight of the fluid, provided that no more than the working member is claimed, i.e., the claim

- must include only the minimum elements for an impeller as defined in Class 416.
- 417, Pumps, appropriate subclasses for a rotary pump* of the positive displacement type in which transportation of the working fluid* from a chamber or enclosure is caused by decreasing the volume of the enclosure, such pump* being claimed, per se, or combined with another pump* of any type; for a pump* in which the runner is mounted for rotary motion and cyclic axial reciprocation, even though it is of the rotary nonexpansible chamber type; for a "black box" pump shown as rotary if not of the expansible chamber type; for a rotary pump* and a specific driving means therefor; see Lines With Other Classes, (1) Note, A and B; for a chain pump of the type comprising pistons mounted on a flexible or endless drive member and in which a casing or housing surrounds and tightly encompasses the pistons, thus forming an expansible chamber pump, and elements (e.g., pistons) of such a pump.
- (1) Note. Bucket Pumps (e.g., receptacles on an endless chain or belt) which retain fluent to be moved to another location will be found in Class 198, Conveyors: Power-Driven.
- (2) Note. Classes 91, Motors: Expansible Chamber Type, 417 Pumps, and 418, Rotary Expansible Chamber Devices, all provide for an expansible chamber device (motor or pump) which may be rotary, the distinction being on the nature of the valving for the working fluid. For clear statements as to the differences among these classes, see the line notes in each class to the others.
- 418, Rotary Expansible Chamber Devices, appropriate subclasses for a rotary motor or pump in which the moving wall of an expansible chamber (1) produces a mechanical force because of expansion of a simple fluid in the chamber reacting against a fixed abutment, or (2) increases the energy of a fluid in the chamber.
- (1) Note. Classes 91, Motors: Expansible Chamber Type, 417, Pumps and 418, Rotary Expansible Chamber Devices, all provide for an expansible chamber device motor or pump, which may be rotary, the distinction being on the nature of the valving for the working fluid. For clear statements as to the differences among these classes see the line notes in each class to the others.
- 454, Ventilation, appropriate subclasses, for a gas pump* in combination with the enclosure to be ventilated and which is specifically recited or which bears a specific relationship with the pump*.

SECTION IV - GLOSSARY

The following terms or words, used throughout the titles and definitions, are set forth with the meaning each is to have in this class. Throughout this bulletin an asterisk (*) following the work or term indicates that reference should be made to this glossary for the specific meaning thereof.

BLADE

A working member on the runner which contacts the working fluid. This member may variously be called a bucket, vane, pocket or float in the art literature.

CASING

A member which cooperates with a runner member and provides a flow path for the working fluid. This member may also be called a curb in the art literature.

DISTRIBUTION MEANS

At least one member positioned in the working fluid flow path and proximate to the runner to convey, guide, distribute or direct the fluid immediately prior or subsequent to its contact with the runner. Encompassed within this term is a pipe, nozzle or vane.

MOTOR

Generally, an apparatus in which one form of energy is changed so that mechanical power is obtained. Specifically for this class, an apparatus for obtaining mechanical power from the kinetic or potential energy in a fluid material contacting a rotary member of the apparatus, as further defined and limited herein.

PUMP

An apparatus used for adding energy to fluid material (gas or liquid).

RUNNER

A member which is or which supports a means contacting a working fluid, the member being mounted or supported so as to be capable of unidirectional rotational or orbital movement for at least one revolution or orbit (in the absence of control means for limiting movement to part of a revolution or orbit), the member being (1) caused to so move by the kinetic or potential energy of the working fluid, or (2) caused to move by some external force to increase the energy (velocity, pressure or potential) in the working fluid by transfer of kinetic energy from the member to the fluid. This member may also variously be called a rotor, wheel, piston or bucket wheel in the art literature.

SHAFT

A member which supports or mounts the runner for unidirectional rotational or orbital movement, the member being itself supported in bearings for rotational motion and is connected to a work producing element when the runner is caused to rotate by working fluid impinging thereon or to a driving force so as to cause the runner to rotate and add energy to work fluid.

VANE

A static partition member (which however may be selectively adjustable to various positions) in the working fluid flow path and shaped (often as an airfoil) to guide or direct fluid flow. This vane member may also variously be called a nozzle, intermediate, diffuser or diaphragm in the art literature.

WORKING FLUID

A fluid material (gas or liquid) which contacts the runner and causes it to move, or has energy added thereto by a driven runner.

SUBCLASSES

- 1 This subclass is indented under the class definition. Process of ACQUISITION PROCURE-
MENT PLAN.
- 2.1 **WITH MEANS FOR CONTROLLING CASING OR FLOW GUIDING MEANS IN RESPONSE TO NATURAL FLUID CURRENT FORCE OR DIRECTION:**
This subclass is indented under the class definition. Device comprising means for adjusting the position or effect of a casing* or other working fluid* flow directing member which

means acts in accordance to the strength or orientation of a flowing, unconfined, and natural working fluid such as a wind or water stream.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 905+, for a natural fluid current motor comprising a casing or flow guiding means which is not controlled in response to current force or direction.

SEE OR SEARCH CLASS:

- 416, Fluid Reaction Surfaces (i.e., Impellers), subclasses 9+ for the combination of an uncased runner (e.g., windmill, etc.) and a guide vane attached thereto for adjusting the position of the runner in a wind or fluid stream, and subclasses 31+ for means for controlling an uncased runner in a wind or fluid stream in response to noncyclic condition sensing.

3.1

Having specific features for water current:

This subclass is indented under subclass 2.1. Device comprising structure particularly adapted to a natural water current environment.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 7, for a device comprising a float supported or buoyant runner.

4.1

Natural fluid current force responsive:

This subclass is indented under subclass 2.1. Device wherein the adjusting means for the casing* or other working fluid* flow directing member acts in accordance to the strength of the flowing, unconfined, and natural working fluid.

- (1) Note. A device comprising means for controlling a casing or other flow guiding member in accordance to runner* shaft* rotation speed is included in this and indented subclasses provided the shaft speed is dependent on the strength of the flowing natural current. However, for a complete search for such subject matter, subclasses 30+ should be searched since those subclasses have not been screened for such subject matter.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 30+, for a device comprising control means responsive to noncyclic condition sensing of runner shaft rotation speed;
- 146, for a device including working fluid force responsive vane* or flow control.
- 148+, for other devices having flow regulating means.

SEE OR SEARCH CLASS:

- 416, Fluid Reaction Surfaces (i.e., Impellers), subclass 41 for an uncased rotor with control means responsive to relative natural fluid current velocity.

4.2 Vertical runner axis:

This subclass is indented under subclass 4.1. Device wherein the runner's* axis of rotation is generally parallel to the force of gravity acting on the working fluid*.

4.3 Axial flow runner:

This subclass is indented under subclass 4.1. Device wherein the working fluid* path to, through, and from the runner* is predominantly parallel to the runner's axis of rotation.

4.4 Vertical runner axis:

This subclass is indented under subclass 2.1. Device wherein the runner's* axis of rotation is generally parallel to the force of gravity acting on the working fluid*.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 4.2, for a device with means for controlling a casing* or flow guiding means in response to natural fluid current force, which device has a vertical runner axis.

4.5 Axial flow runner:

This subclass is indented under subclass 2.1. Device wherein the working fluid* path to, through, and from the runner* is predominantly parallel to the runner's axis of rotation.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 4.3, for a device with means for controlling a casing* or flow guiding means

in response to natural fluid current force, which device has an axial flow runner.

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This subclass is indented under the class definition. Apparatus in which the runner* comprises an endless, elongated flexible member, e.g., a chain or belt, which carries at least one blade* or which has a surface which functions like a blade.

SEE OR SEARCH CLASS:

- 198, Conveyors: Power-Driven, subclass 702, for a conveyor section of the bucket type which is particularly adapted to convey liquid; e.g., a water elevator.
- 417, Pumps, subclass 320 for an endless chain pump comprising serially arranged pumping chamber, i.e., an endless chain having pistons or similar extension in a tight fitting casing so that the space between each piston or other obstruction and the inlet or outlet of the casing forms in effect an expansible chamber.

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This subclass is indented under the class definition. Apparatus comprising a container or conducting means for liquid which is so supported for motion that it sequentially (1) is immersed in a body of liquid, (2) retains a portion of such liquid, (3) is raised out of the body of liquid and (4) discharges such retained liquid, and repeats such sequence of steps.

SEE OR SEARCH CLASS:

- 198, Conveyors: Power-Driven, subclasses 638+ for an endless band or belt of material adapted to dip into a liquid source, retain the liquid thereon by capillarity or absorption, raise the liquid and then discharge it by centrifugal force; and subclasses 701+ for a device similar to that described above, except that discharge is by means other than by centrifugal force.

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This subclass is indented under the class definition. Apparatus comprising a runner* or runner* sustaining means which is intended during use to be supported by a liquid and is buoyant in said liquid.

- (1) Note. A ship or boat recited so nominally as to preclude classification on its features is included under this definition of float.

SEE OR SEARCH CLASS:

- 60, Power Plants, subclasses 495+ for motors having a buoyant working member motivated by the vertical rise and fall of the surface of a body of fluid.
- 417, Pumps, subclass 61, for a pump which is buoyantly supported or which has its inlet or outlet buoyantly supported.

- 8** This subclass is indented under the class definition. Apparatus comprising a driven runner which is submerged wholly or partially in a fluid, and a means in the path of the fluid current to or from the runner to guide or direct the current, there being no conduit confining the fluid current at the location of said means.

- (1) Note. Included under this definition are outboard motor-type propellers having a deflector or guide in the path of the fluid from the propeller to change the course or direction of the fluid to control the speed or direction of the boat (e.g., trolling); also included are fan runners* having directional guide vanes* spaced therefrom.
- (2) Note. The means to guide and direct the current must be in addition to the usual rudder for steering a boat.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 148+, for means to affect the direction, amount, velocity or whirl of the working fluid in a system where the fluid is confined.

SEE OR SEARCH CLASS:

- 416, Fluid Reaction Surfaces (i.e., Impellers) appropriate subclasses for the runner, per se, in the absence of a directing means.
- 440, Marine Propulsion, appropriate subclasses, for ship structure combined with a propeller and a rudder.

- 9** This subclass is indented under the class definition. Apparatus comprising a member or element which is intended to be mutilated, torn, broken, melted or destroyed so that it can not be re-used, but must be replaced, while other members remain in a usable condition.

- (1) Note. Patents in this subclass usually are of the type where an element fails on overspeed, to prevent destruction of the entire unit.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 173.4, and 174.4, for a bearing, seal, or liner member positioned between a portion of the runner* and a static part which bearing, seal, or liner is intended to be eroded, abraded or permanently deformed.

- 10** This subclass is indented under the class definition. Apparatus comprising a control means reacting to the force of the small generally circular fluid currents, or to the electrical or magnetic force generated by motion of the shaft* or an element associated there with in a fluid atmosphere or in a magnetic field.

- (1) Note. If any part of the generated fluid or electrical force is used for a purpose other than the control means (as claimed) it is considered to be specific load and is excluded from this Class, see Main Class Definition, section III, (2) Note, B.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 26, for a control means reacting to the force exerted by a fluid whose velocity or pressure has been increased by the runner* or other shaft* associated member.

SEE OR SEARCH CLASS:

- 290, Prime-Mover Dynamo Plants, subclass 4 for a prime mover dynamo plant comprising plural prime movers of the turbine type and having means to control operation of the turbines in response to electrical conditions, and subclasses 51-55 for a prime-mover

- dynamo plant comprising a turbine or other fluid motor and means to regulate the motor in response to electrical conditions.
- 700, Data Processing: Generic Control Systems or Specific Applications, subclasses 1 through 89 for data processing control systems wherein the control system is claimed generically, subclass 281 for control of fluid level or volume, subclasses 282-285 for flow control, and subclasses 287-290 for turbine or generator control.
- 702, Data Processing: Measuring, Calibrating, or Testing, subclasses 45+ for flow metering, and subclasses 50+ for fluid measurement.
- 11** This subclass is indented under the class definition. Apparatus comprising a fluid system downstream of a pump* and having a branched passage leading back to the pump* inlet with a means responsive to a characteristic or condition of the fluid controlling the passage.
- (1) Note. The characteristic or condition may be that of the fluid upstream or downstream of the pump*.
- (2) Note. Typical examples of characteristic or condition of the fluid are pressure, velocity, density.
- 12** This subclass is indented under the class definition. Apparatus comprising a blade*, vane* or means to move the blade or vane relative to a fixed point made of a plurality of dissimilar metals to provide for movement of the blade or vane upon variation in temperature.
- 13** This subclass is indented under the class definition. Apparatus comprising (1) means to sense a condition which may or may not occur, a change in such condition, a lack of such condition, or a result of such condition, and a separate control means for an apparatus part, the sensing means causing or permitting operation of the separate control means without the intervention of a human attendant, (2) means mounted so as to rotate and assume various radial positions in accordance with the rate of its rotation, and at a predetermined rate, to operate a control means for an apparatus part, or (3) means responding to a turning or twisting motion of a rotating member to impose a control on an apparatus part.
- (1) Note. A timer clockwork or cyclical mechanism which operates at predetermined intervals of time or motion is not included under this definition of automatic control; a float which has a portion thereof also acting as a valving element is included under this definition; a check valve or similar valve element which is directly responsive to fluid flow is not included; a valve having connected thereto a separate surface which responds to pressure is included.
- (2) Note. The centrifugally actuated element must be one in addition to the minimum required for the apparatus under the class definition, i.e., a runner* and a means to direct working fluid* to, from or through the runner*. Thus, a centrifugally moved blade* or connecting means between the blade* and its support is not proper subject matter under this definition and will be found in subclasses 140+.
- 14** This subclass is indented under subclass 13. Apparatus in which the control function is initiated when the runner, its housing or its supporting member has (1) made a predetermined part of a cycle or number of cycles or (2) moved to a predetermined point in space.
- 15** This subclass is indented under subclass 13. Apparatus in which the control function is initiated after a comparison between a reference signal from a separate source and the sensed condition.
- 16** This subclass is indented under subclass 13. Apparatus in which the control function is initiated at a predetermined speed of a runner* in combination with means which may be operated for testing purposes to initiate the control function when the runner* is not operating at said predetermined speed.
- 17** This subclass is indented under subclass 13. Apparatus in which the operation of the control means is caused or permitted by means which senses and responds to two different conditions.

- (1) Note. Examples of different conditions are: speed, temperature, pressure, attitude.
- (2) Note. Speed of the moving motive member and the load thereon (or resistance to movement) are directly related; therefor speed and load are considered to be the same condition.
- (3) Note. Included under this definition is a sensing means comprising a single element which can respond to plural different conditions.
- 18** This subclass is indented under subclass 13. Apparatus comprising means to (1) cause an apparatus surface part which is associated with a separate and distinct moving surface to frictionally engage and control, retard or stop said moving surface or (2) cause two members to either engage or disengage to transmit or to prevent motion from one to the other.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
123, for clutch or brake surfaces which are manually actuated.
- SEE OR SEARCH CLASS:
477, Interrelated Power Delivery Controls, Including Engine Control, for interrelated control between a motor* and a transmission, clutch, or brake.
- 19** This subclass is indented under subclass 13. Apparatus comprising (1) a motor for initiating runner* rotation or (2) a member for adjusting runner blade position, and in combination with (1) or (2) a control means which responds to a predetermined condition of operation to deactivate the starter motor or to move the runner blades from the initial starting position.
- 20** This subclass is indented under subclass 13. Apparatus comprising a control for the amount of working fluid flowing in a confined path and for adjusting the position of another element or part which does not affect such amount.
- (1) Note. The amount of fluid flowing may be controlled by a valve in the supply line, in a relief or bypass line, or in the discharge line or tailgate.
- (2) Note. Shifting the direction of discharge of the motive fluid, or imposing a deflector element in the path of the free jet, is not considered to be a control for the amount of motive fluid flow.
- 21** This subclass is indented under subclass 20. Apparatus in which the other element or part comprises (1) the runner*, (2) any part thereof, or (3) its connection or support means on a shaft.
- 22** This subclass is indented under subclass 21. Apparatus in which the element or part comprises a runner* which is positioned between two sets of vanes*, one set guiding flow to the runner*, the other set from the runner*.
- (1) Note. The fluid flow guide vanes may themselves be movable relative to a fixed member.
- (2) Note. Many patents herein disclose the use of the apparatus as either a turbine or a pump* the flow guide vanes being movable to various positions to vary the working fluid* velocity (turbine) or pressure (pump).
- 23** This subclass is indented under subclass 13. Apparatus in which the condition sensed is the angle at which the working fluid* leaves a blade* or vane*.
- 24** This subclass is indented under subclass 13. Apparatus in which the condition sensed is the level of a liquid or the weight effect of a mass of liquid to initiate the control function.
- 25** This subclass is indented under subclass 13. Apparatus comprising a runner* or shaft* and means to regulate flow of fluid in or through the runner* or shaft*, the regulating function started as a result of centrifugal force.
- (1) Note. The regulating means may be positioned within or without the shaft* or runner*.
- (2) Note. The regulating means may be subjected to the centrifugal force or may be

- operated by another device subjected to centrifugal force.
- 26** This subclass is indented under subclass 13. Apparatus in which the runner* or another means secured to and moving with the runner supporting shaft acts on a fluid to increase its velocity or its pressure and the sensing means responds to a force exerted by the fluid after being acted upon by the runner* or such other means.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
175, for a separate, connected pump for circulating lubricant and not involving automatic control.
- SEE OR SEARCH CLASS:
417, Pumps, subclasses 1+ for a rotary kinetic fluid pump comprising a working fluid condition responsive motor control; and subclasses 279+ for a rotary kinetic fluid pump with a working fluid condition responsive bypass.
- 27** This subclass is indented under subclass 26. Apparatus comprising a driven runner and a branched fluid conduit downstream of the runner, one branch leading to a point of use for the fluid, the other branch being valved and discharging to atmosphere when the valve is actuated as a result of the sensing means responding to the force exerted by the fluid.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
11+, for pumps and recirculation passages leading back to the pump inlet in response to a means sensing or condition of the working fluid.
- 28** This subclass is indented under subclass 26. Apparatus comprising a plurality of runners or blade rows with a valve so arranged as to permit at least a portion of the working fluid either to pass through a runner or blade row or to be bypassed around so as not to be acted upon by a blade row, the valve actuated as a result of the sensing means responding to the force exerted by the fluid.
- 29** This subclass is indented under subclass 26. Apparatus comprising means to regulate the flow of working fluid* to the runner* of a motor*.
- (1) Note. Typical of the devices included under this definition is a motor* in which a small pump* driven by the shaft acts on a fluid, the pressure of which acts on a means controlling flow of working fluid* to the motor.
- 30** This subclass is indented under subclass 13. Apparatus in which the control operation is initiated in response to a predetermined rate of movement of the runner* or to a rate proportional to such predetermined rate or to a twisting or turning motion of a rotating member associated with the runner* or shaft*.
- 31** This subclass is indented under subclass 30. Apparatus comprising a runner* having a blade* which is wrapped or coiled at least 360° around an axis.
- (1) Note. The blade* may extend longitudinally or the edges may all be in a plane.
- 32** This subclass is indented under subclass 30. Apparatus comprising in addition means actuated by a human attendant to return the control system to a datum, point, to override or prevent operation of the control system, or to otherwise selectively modify or affect the operation of the control system.
- 33** This subclass is indented under subclass 30. Apparatus in which a means for actuating a relatively movable runner*, blade*, runner* support or part in which the runner* support turns or revolves is controlled.
- 34** This subclass is indented under subclass 33. Apparatus in which the runner*, blade*, shaft* or part in which the shaft* turns or revolves is movable along the axis around which the runner* normally moves during operation.
- 35** This subclass is indented under subclass 30. Apparatus comprising a nozzle discharging working fluid* towards the runner* and in which the control means is a barrier movable

into and out of a position intercepting and redirecting the working fluid*.

- 36** This subclass is indented under subclass 30. Apparatus in which the control operates a device which varies the quantity of working fluid* flowing in a confined path or the position of a vane* or other flow directing or guiding means.

- 37** This subclass is indented under subclass 36. Apparatus in which the means controlling the quantity of working fluid* flowing is located intermediate a plurality or rows or series of blades*, or within a passage which redirects the working fluid* back to the same blade* or series of blades* from whence it was discharged.

SEE OR SEARCH THIS CLASS, SUBCLASS:

11+, for means to recirculate fluid back to a pump runner and a control means therefor responsive to a condition or characteristic of the working fluid.

52.1+, for guide vanes or valves in re-entry or recirculation passages where no automatic control is involved.

- 38** This subclass is indented under subclass 36. Apparatus comprising control means for a plurality of passages for flow of working fluid*, said control means being operable to permit flow serially through the passages or to permit flow through one passage while shutting off flow through another.

- 39** This subclass is indented under subclass 38. Apparatus in which said control means comprise a plurality of regulators including one controlling the amount of working fluid* discharged towards the runner* and another controlling the amount of working fluid* discharged away from the runner* prior to action on the runner*.

- 40** This subclass is indented under subclass 38. Apparatus comprising a source of mechanical power caused to move by virtue of a fluid acting thereon to operate said control means.

SEE OR SEARCH THIS CLASS, SUBCLASS:

43, for other valve actuators comprising a fluid servomotor and pilot valve therefor controlled by a speed responsive means.

- 41** This subclass is indented under subclass 36. Apparatus including disabling means which prevents operation of a flow controlling means until the disabling means is moved or caused to move from its disabling position.

(1) Note. Many of the patents in this subclass involve an emergency stop valve which is latched in open position and an emergency governor which at a predetermined speed, trips the latch and permits the emergency stop valve to close.

- 42** This subclass is indented under subclass 36. Apparatus in which the actuator for the means controlling the quantity of working fluid* or the position of a vane* includes the runner* or a distinct and independent source of mechanical power.

- 43** This subclass is indented under subclass 42. Apparatus in which the distinct and independent source of mechanical power is a fluid actuated means which supplements and which is actuated by fluid from a pilot valve controlled by the means reacting to the rate of movement of the runner*.

- 44** This subclass is indented under subclass 36. Apparatus comprising means to direct or conduct a plurality of distinct fluid streams onto the runner.

(1) Note. Included under this definition is a single control regulating flow to a plurality of branches each of which discharges onto the runner.

- 45** This subclass is indented under subclass 44. Apparatus in which the means lie in a plane which is normal to the runner axis and passes through at least a portion of the runner blade.

- 46** This subclass is indented under subclass 36. Apparatus in which the flow controlling member or the vane* is located in the path of the

working fluid* after the fluid has acted on the runner.

- 47** This subclass is indented under subclass 13. Apparatus in which the sensing means reacts to a predetermined force exerted by a fluid or to predetermined temperature.

- 48** This subclass is indented under subclass 47. Apparatus in which the sensing means controls means which positively moves or shifts the position of a runner, runner supporting shaft, blade, or vane relative to other apparatus parts.

- 49** This subclass is indented under subclass 47. Apparatus comprising sensing means which reacts to the force exerted by a fluid for controlling the flow of working fluid.

(1) Note. The sensing means may react to the force of working fluid or another fluid for controlling working fluid flow.

- 50** This subclass is indented under subclass 49. Apparatus in which the sensing means reacts to fluid pressure to control the flow of working fluid relative to two or more separate and distinct runners.

(1) Note. The control means may comprise a single valve, or a plurality of valves, for controlling flow to or from a plurality of runners.

- 51** This subclass is indented under the class definition. Apparatus comprising a means driven or actuated independently of the runner* to control the flow of working fluid* to or from the runner* (1) in accordance with a predetermined scheme of operation embodied in a physical form and not involving the intervention of a human being other than to set it in operation or (2) at a particular time of day or after a predetermined delay period.

SEE OR SEARCH CLASS:

137, Fluid Handling, subclass 624.11 for similar control of a fluid distribution system but not involving a pump or motor runner.

- 52.1 WITH MEANS FOR REENTRY OF WORKING FLUID TO BLADE SET (E.G.,**

REENTRY TYPE DEVICE, PASSAGE, ETC.):

This subclass is indented under the class definition. Device comprising means for directing working fluid* which has previously contacted a first runner* blade* or blade row back to the blade or blade row. The means comprises an arrangement or shape of the blade(s) or an associated working fluid flow guide or casing*.

(1) Note. Included in this subclass is a device wherein significance is attributed to its being of a particular type (e.g., regenerative turbine, side channel blower, cross flow pump, etc.) or configuration, if the type or configuration inherently operates to redirect working fluid back to a blade or blade row; working fluid reentry need not be specifically claimed in such instances.

(2) Note. A row (set) of blades comprises at least two physically interrelated blades which cooperate with each other to form a single composite structure against which the working fluid may act. The blades of a row may be arranged relative to each other to form any one of a variety of shapes (e.g., circle, spiral, etc.) but usually comprise a single circular annulus.

(3) Note. A single runner may have thereon a plurality of rows (i.e., sets) of blades. For classification under this definition, the working fluid must be directed to the same row of blades it previously contacted. See subclasses 64, 66, 67, 93, 103, and 198.1+, for apparatus in which the working fluid is directed to another row of blades after contacting a first row.

(4) Note. A device merely comprising a closed container with a pump which recirculates working fluid in the container is not included in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

11+, for a pump* comprising a passage means for the reentry of working fluid to a runner, which means includes a passage control means responsive to a

- condition or characteristic of the working fluid.
- 37, for a device comprising means for the reentry of working fluid to a runner, which means includes a working fluid controlling valve responsive to the runner's shaft speed or torque.
- 225, for a device having an exit chamber axially offset from the runner which may permit some working fluid reentry to a blade or blade set.
- 53.1 Cross flow runner:**
This subclass is indented under subclass 52.1. Device comprising a runner* blade* row which forms a hollow cylinder. The working fluid* in the device flows from a position outside and on one side of the cylinder through the blade row to a position inside the cylinder and then again through the blade row to a position outside and generally on the other side of the cylinder.
- (1) Note. The working fluid* usually flows in a direction perpendicular to the runner's axis of rotation.
- (2) Note. Cross flow-type runners may also be referred to as transverse flow runners.
- 53.2 Having vane or deflector within runner blade set:**
This subclass is indented under subclass 53.1. Device comprising a working fluid* guiding vane* or other means which is positioned inside the blade row to guide working fluid inside the blade row.
- 53.3 Having selectively adjustable vane or working fluid control means:**
This subclass is indented under subclass 53.1. Device comprising a working fluid* guiding vane* or other means which may be moved positively and at will and may be retained in any one of a multiplicity of different positions to vary the direction or amount of working fluid flow.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 53.2, for a cross flow runner* device having a selectively adjustable vane or deflector within a runner blade* set.
- 148+, for a selectively adjustable vane or working fluid control means in a non-reentry device.
- 54.1 To opposite face of blade:**
This subclass is indented under subclass 52.1. Device wherein the working fluid* directed back to the blade* or blade row is directed to a surface (i.e., face) of the blade or blade row on the other (i.e., back) side of a surface previously contacted by the working fluid.
- (1) Note. In most instances, the arrangement under this definition is for the purpose of slowing down the runner since the redirected fluid acts on the blade in a direction opposite to that in which the working fluid originally acts.
- 55.1 Turbine regenerative pump:**
This subclass is indented under subclass 52.1. Device comprising a casing* having a ring shaped channel around the runner's axis of rotation within and which the first runner blade row rotates to add energy to working fluid* passing through the channel (i.e., pump*). A (regenerative) portion of the channel lies between a circumferentially spaced working fluid channel inlet and outlet which portion (a) has a significantly greater cross section than does the blade row and (b) is configured to direct the working fluid along a helical path out of and back into contact with the blade row.
- (1) Note. The channel is usually perpendicular to and along an arc of constant radius centered upon the runner's axis of rotation.
- (2) Note. The working fluid must be directed back into contact with a blade row by design. A device wherein working fluid is incidentally directed back into contact with a blade row (e.g., as in a centrifugal volute pump) is not included in this subclass.
- (3) Note. A regenerative turbine pump may also be referred to as a vortex pump, a side channel blower, a ring channel blower, etc.

55.2 Having specific means to deflect working fluid in regenerative passage:

This subclass is indented under subclass 55.1. Device wherein particular significance is attributed to a working fluid* guiding vane* or other means which guides the working fluid passing within the (regenerative) channel portion.

- (1) Note. Working fluid flow guides positioned at the working fluid entrance or exit to the (regenerative) channel portion are included in this subclass.

55.3 Means extends parallel to passage:

This subclass is indented under subclass 55.2. Device wherein the working fluid* directing or guiding means is located within the (regenerative) channel portion and generally extends coincidentally with (i.e., parallel to) the channel portion.

55.4 Positioned at passage end (e.g., stripper seal, etc.):

This subclass is indented under subclass 55.2. Device wherein the working fluid* conducting, guiding, or distributing means is positioned generally at a circumferential limit (i.e., end) of the (regenerative) channel portion.

- (1) Note. A device having a stripper seal which prevents or retards working fluid* from passing from the working fluid outlet of the channel portion to the working fluid inlet of the channel portion is included in this subclass.

55.5 Having plural, rigidly related blade sets:

This subclass is indented under subclass 55.1. Device further comprising a second runner* blade* row which is fixedly or unitarily associated with the first blade row.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 198.1+, for a nonreentry device having plural, rigidly related blade sets and see the search notes therewith.

55.6 Acting serially but nonalternating (e.g., multistage, etc.):

This subclass is indented under subclass 55.5. Device wherein the working fluid* contacts the first and second blade* rows in sequence but wherein the working fluid* is not acted upon by the first blade row, then by the second blade row, and then again by the first blade row (i.e., alternating blade row contact).

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 199.1+, for a device having plural, serial, radial flow blade sets and an intermediate stationary flow diverter.

55.7 In separate regenerative passages:

This subclass is indented under subclass 55.5. Device wherein the first and second blade rows pass through (regenerative) portions of different channels.

- (1) Note. The different channels may be interconnected at certain locations such as at a common working fluid* exit or entrance.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 55.6, for a regenerative turbine pump* having serially acting, plural, rigidly related blade sets within separate regenerative passages.

56.1 Pump priming means:

This subclass is indented under subclass 52.1. Device comprising means for directing a portion of liquid working fluid* to the first runner* blade* or row of blades, which liquid portion has previously been acted upon by the blade or row of blades (i.e., pump* devices). The means acts to displace gaseous fluid (e.g., air, etc.) in the device replacing it with liquid working fluid (e.g., water, etc.).

- (1) Note. The means usually functions exclusively during the startup of the device in order to facilitate reaching steady state operation.

56.2 Vertical runner shaft:

This subclass is indented under subclass 56.1. Device comprising an axis about which the runner blade* or blade row rotates, which axis is generally parallel to the force of gravity acting on the working fluid.

56.3 Having plural and arcuately arranged vanes around runner:

This subclass is indented under subclass 56.1. Device comprising two or more vanes* or other working fluid* directing means positioned about and radially outward of the runner*.

56.4 Reentry through working fluid discharge passage for runner:

This subclass is indented under subclass 56.1. Device comprising a conduit through which the (reentry) working fluid* portion is directed to the runner* blade* or blade row, which conduit also serves to guide the working fluid away from the runner blade or blade row.

- (1) Note. The conduit usually directs the working fluid reentry portion to the runner blade or blade row during pump* startup (priming) and directs working fluid away from the runner after priming has been completed.

56.5 Reentry working fluid joins inlet working fluid upstream of runner:

This subclass is indented under subclass 56.1. Device wherein the means directs the (reentry) working fluid* portion to a location where working fluid flowing to the runner* has not yet been acted upon by the runner (i.e., upstream of the runner and prior to initial entry to the runner), at which location the (reentry) working fluid portion is merged with the working fluid flowing to the runner.

56.6 Walled pumping chamber within liquid separation chamber:

This subclass is indented under subclass 56.1. Device wherein the means comprises one area in which the pump* runner* is located and a second area radially outward of and radially enclosing the one area. The two areas are set apart by one or more casing* partitions or walls. The second area comprises means to remove or separate gas from the liquid working

fluid* discharged from the runner and means to return the discharged liquid working fluid to the blade* or blade row.

57.1 Plural, independent, serially acting reentry means:

This subclass is indented under subclass 52.1. Device having two or more such (reentry) means each separately directing working fluid* which has previously contacted the first runner* blade* or blade row back to the blade or blade row. The two or more means act in sequence (i.e., one after the other) on the working fluid flowing through the device.

57.2 Having additional blade set in reentry path:

This subclass is indented under subclass 57.1. Device comprising a second blade* row which contacts the working fluid* after the first blade or blade row but before one of the reentry means has directed the working fluid back to the first blade or blade row.

57.3 Reentry from opposite sides of blade face:

This subclass is indented under subclass 57.1. Device wherein two of the (reentry) means direct the working fluid* back to the first blade or blade row from separate locations which locations substantially confront (oppose) each other across the blade or the blade row.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 54.1, for a device comprising means for directing (reentry) working fluid to a face of the blade or blade row opposite that face which was first contacted by the working fluid.

57.4 Reentry into blade in radial plane of blade:

This subclass is indented under subclass 57.1. Device wherein one of the (reentry) means directs the working fluid* into the blade* or blade row along a direction generally contained in a plane perpendicular to the runner's* axis of rotation which plane passes through the blade or blade row.

- (1) Note. The (reentry) flow directed back to the blade or blade row can be in any direction prior to being directed into the blade or blade row.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

57.3, for a device having plural, independent, serially acting means for the reentry of working fluid to a blade or blade row wherein reentry is from opposite sides of a blade face; such working fluid reentry may be in a radial plane which passes through the blade or blade row.

58.1 Having additional blade set in reentry path:

This subclass is indented under subclass 52.1. Device comprising a second blade* row which contacts the working fluid* after the first blade or blade row but before the (reentry) means has directed the working fluid back to the first blade or blade row.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

57.2, for a device having plural, independent, serially acting reentry means one of which directs the working fluid through an additional blade set after the working fluid has contacted the first blade set but prior to the working fluid being returned to the first blade set.

58.2 Radial flow runner portion guides reentry working fluid (e.g., hub, back plate, etc.):

This subclass is indented under subclass 52.1. Device wherein the working fluid* flows through the runner* in a direction predominantly inwardly toward or outwardly from the runner's axis of rotation. The runner comprises a structure which assists in directing the working fluid which has previously contacted the blade* or blade row back to the blade or blade row.

- (1) Note. The structure which assists in directing the working fluid back to the blade or blade row may comprise a hub, back plate, shroud, etc., of the runner.
- (2) Note. A circumferential or transverse (i.e., cross) flow runner is not considered to be a radial flow runner for the purposes of this and indented subclasses.

58.3 Runner inlet shroud:

This subclass is indented under subclass 58.2. Device wherein the runner* structure which assists in directing the working fluid* back to the blade* or blade row comprises a ring shaped rim member (shroud) centered about the runner's axis of rotation and located at a working fluid entrance to the runner.

- (1) Note. The rim member (shroud) is usually carried on or supported by a blade or blade row of the runner.

58.4 Reentry working fluid joins inlet working fluid upstream of runner:

This subclass is indented under subclass 52.1. Device wherein the means directs the (reentry) working fluid* portion to a location where working fluid flowing to the runner* has not yet been acted upon by the runner (i.e., upstream of the runner and prior to initial entry to the runner), at which location the (reentry) working fluid portion is merged with the working fluid flowing to the runner.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

56.5, for a pump device having priming means wherein reentry working fluid joins inlet working fluid upstream of the runner.

58.5 Axial flow runner:

This subclass is indented under subclass 58.4. Device wherein the working fluid* flow to, through, and from the runner is predominantly parallel to the runner's axis of rotation.

58.6 Open recirculation from and to blade set:

This subclass is indented under subclass 52.1. Device wherein the (reentry) means directs the working fluid* from and back to the blade* or blade row along a circulatory path which lies entirely within an unconfined and unobstructed (i.e., open, nonpassageway) area.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

53.1+, for a cross flow runner incorporating a fluid vortex which directs working fluid to and from a blade set in open recirculation.

- 55.1+, for a turbine regenerative pump which has open recirculation of working fluid from and back to a blade set.
- 57.1+, for a device having plural, serially acting, and open recirculation means for the reentry of working fluid from and back to a blade or blade set.
- 225, for a device having an exit chamber axially offset from a runner which device may disclose structure which involves some open recirculation of working fluid from and back to a blade set.

58.7 Axial flow runner:

This subclass is indented under subclass 52.1. Device wherein the working fluid* flow to, through, and from the runner* is predominantly parallel to the runner's axis of rotation.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 58.5, for a device having an axial flow runner wherein reentry working fluid joins inlet working fluid upstream of the runner.

59.1 Plural blade sets:

This subclass is indented under subclass 52.1. Device comprising two or more blade* rows.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 55.5+, for a turbine regenerative pump having plural, rigidly related blade sets.
- 57.2, for a device having plural, independent, serially acting working fluid reentry means for a blade or blade set and an additional blade set in one of the reentry paths.
- 58.1, for a device having working fluid* reentry means to a blade or blade set and an additional blade set in the reentry path.

- 60 This subclass is indented under the class definition. Apparatus comprising at least two runners*, each capable of movement relative to the other on the same supporting member, or each fixed to its own supporting member and moving independently of the other.

- (1) Note. Included under this definition is a device comprising a plurality of run-

ners*, any of which may be selectively and alternately connected to the shaft* at any one time, the other or others being held against rotation, thus in effect comprising a casing* or stator* assembly, or a pump* comprising a plurality of impellers, any of which can be selectively fixed to the shaft* for rotation therewith or left to free wheel on the shaft*, to vary the output and or discharge pressure. For such a device as described above, see subclass 61.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 61, for apparatus which may have a plurality of runners* and means to selectively connect and disconnect a runner* and its supporting shaft*.

- 61 This subclass is indented under subclass 60. Apparatus comprising an arrangement by which less than all the runners may at will be (1) contacted by the working fluid* or (2) drivingly associated with the input or output shaft.

- (1) Note. Typically the arrangement may include a valve for directing the working fluid* to or from a runner*, a clutch mechanism to connect any runner* to or from a shaft*, or a brake mechanism to frictionally engage and prevent the motion of any runner.
- (2) Note. Included under this definition is a pumping arrangement wherein the runners* may selectively be changed between a series and parallel system.

- 62 This subclass is indented under subclass 60. Apparatus comprising at least two distinct and different types of runners*, arrangements of blades* or directions of the working fluid* flow paths across the runner*.

- (1) Note. The different arrangements of blades may be on a single runner; for example there may be a radial flow blade system and an axial flow blade stream, both systems fixed to and rotating on a single runner disc or hub.

- (2) Note. Examples of different types of runners are: reaction, impulse, radial flow, axial flow, spiral or friction.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 81, for a runner* in which there is an interior flow path for working fluid* extending to the periphery of the runner* and discharging through a stream modifying orifice to cause rotation due to reaction of the discharge and also having a set of blades* on which the fluid discharging from the orifice impinges.
- 84, for a runner* having radial flow along plural concentric annular blade* series or rows and a peripheral blade* row of the axial flow type.
- 143, for a device having a plurality of separate and distinct runners*, in which the working fluid flows in or along one runner* in a path distinctly different type than it follows in at least one other runner*.

- 63** This subclass is indented under subclass 62. Apparatus comprising at least one runner* having a interior flow path for working fluid* extending to the periphery of the runner* and discharging through a stream modifying orifice to cause rotation of the runner in a direction opposite, and as a result of the reaction to, the fluid discharge.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 25, for a reaction-type runner with a centrifugally, automatically or torque actuated valve member for the fluid conduit.
- 80+, for reaction-type runners*.

SEE OR SEARCH CLASS:

- 239, Fluid Sprinkling, Spraying, and Diffusing, subclasses 251+ for a reaction-type device for sprinkling, spraying or diffusing the discharged fluid into the ambient atmosphere.

- 64** This subclass is indented under subclass 60. Apparatus in which the working fluid flow path is generally radial and contacts a plurality of

annular blade* rows on said runners*, the rows having a common center, each annular blade* row having a radius different from the next adjacent annular blade* row.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 83+, for a single runner* having annular blade* rows on a common radial plane.

- 65** This subclass is indented under subclass 60. Apparatus in which the working fluid* flows along a path that is generally axial and contacts a plurality of blade* rows on said runners*, the rows having a common axis, the blades* of adjacent rows extending in opposite directions from their supports, the blades* of one row extending inwardly and the blades* of another row extending outwardly, at least one row of blades* extending into the spaces between the blades* of the two next adjacent rows extending in the opposite direction.

- 66** This subclass is indented under subclass 60. Apparatus in which the runners* are spaced in the path of the working fluid* and each succeeding runner* is acted upon by the fluid which has left the runner* next upstream thereof.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 64, for plural runners* supported for relative motion or on separate shafts*, with working fluid* passing serially from one to the other, the flow being radial through concentric, radially spaced blade rows.
- 65, for plural runners* supported on separate shafts* or for relative motion, the blades* being interdigitated, oppositely extending, coaxially and axially spaced, the working fluid* following an axial path.

- 67** This subclass is indented under subclass 66. Apparatus in which each runner* has applied thereto a working fluid* stream which has not acted on any other runner* these fluid streams then acting on the next runner in any, in the flow path.

- 68** This subclass is indented under subclass 66. Apparatus in which the runners* rotate about the same axis.
- 69** This subclass is indented under subclass 68. Apparatus in which one runner supporting member encircles or passes completely around another supporting member.
- 70** This subclass is indented under the class definition. Apparatus comprising a runner* (1) which moves around an axis while the axis is continuously moving its position relative to a fixed support, (2) whose transverse face is oblique or not perpendicular to the axis of the shaft* or (3) which rotates around its axis while continuously rotating around another fixed axis.
- (1) Note. Examples of such motion are planetary or nutating.
- SEE OR SEARCH CLASS:
74, Machine Element or Mechanism, subclasses 5+ for gyroscopes as defined in (1) Note therein.
- 71** This subclass is indented under the class definition. Apparatus comprising (1) a blade* coiling around a runner* or (2) a working fluid* conduit in the peripheral wall or interior of a runner*, coiling around or through the runner*, the blade* or conduit, while coiling, approaching or receding from the runner* axis or advancing axially of the runner*, and passing at least once completely around the runner*.
- (1) Note. Under this definition the conduit must completely limit the peripheral extent of the working fluid*.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
6, for a device having a liquid conduit of spiral form and mounted in or on a runner* for sequential dipping into a fluid source, elevating the fluid to a higher level while retaining the fluid in the conduit and then discharging the fluid.
- SEE OR SEARCH CLASS:
198, Conveyors: Power-Driven, subclasses 657+, 724, 756+, and 778 for a spiral conveyor in a loose casing so that no pressure increase is attained in moving fluent material.
- 416, Fluid Reaction Surfaces (i.e., Impellers), subclasses 176+ for the subcombination of the spiral blade* on a rotating shaft* where no means are provided (e.g., flange) for retaining material on the blade*.
- 72** This subclass is indented under subclass 71. Apparatus in which the blade* or conduit coils around the runner* axis while advancing in a direction axially of the runner*.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
168.3, for a device including means for handling working fluid* leakage through a seal between a runner* or shaft* and a static part which means comprises a screw-type pumping seal.
- 73** This subclass is indented under subclass 72. Apparatus comprising a working fluid* conduit.
- 74** This subclass is indented under subclass 72. Apparatus comprising a surface, in addition to the coiled blade* or conduit, for impingement of the working fluid* thereon.
- (1) Note. The surface may be an integral part of the blade* or may be fixed to the casing*.
- 75** This subclass is indented under subclass 72. Apparatus comprising a motor runner* around which the blade coils.
- 76** This subclass is indented under the class definition. Apparatus comprising a runner* having a plurality of spaced surfaces, the working fluid* passing through the spaces and the surfaces being in the form of sinusoids or comprising alternate ridges and grooves.
- (1) Note. In order to qualify under this definition, the working fluid* must travel a tortuous path through or against the run-

ner*. A runner* made of a complementary corrugated or sinuous surfaces which, however, permits the working fluid* to pass therethrough in a path which is not tortuous, corrugated or sinuous is excluded under this definition.

- 77** This subclass is indented under the class definition. Apparatus comprising a runner* on which blades* are mounted and project in rows radially inwardly and outwardly from both circular peripheries of a ring member, the direction of projection of the blades* being along a radial plane passing between the member and the axis of a member supporting the ring member, the blades* being arranged for passage of working fluid* in a direction generally parallel to the axis of the support member.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 60+, for a similar runner* in combination with another runner* of the same or different type and moving independently on the same or another shaft*.
- 87, for a runner* having a plurality of concentric annular series of blades* projecting axially from both sides of the runner* face which is transverse to the axis of a runner* supporting shaft*, working fluid* flow being generally in a radial direction along the face.

- 78** This subclass is indented under subclass 77. Apparatus comprising a means to chose at will the single row of inwardly or outwardly extending blades* for traverse of the working fluid*.

- (1) Note. Typically, included herein are turbines, the rotation of which is reversed by sending the working fluid* through one or another of concentric blade* rows.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 61, for plural runners* supported for relative motion or on separate shafts* with means for selecting the runner* to which working fluid* is passed.

- 79** This subclass is indented under subclass 77. Apparatus comprising and arrangement on which the working fluid*, after passing axially through the blades* on one of said peripheries is passed to the blades* on the other of said peripheries for axial flow therethrough.

- 80** This subclass is indented under the class definition. Apparatus comprising a runner* having an interior flow path for working fluid* extending to the periphery of the runner* and discharging through a stream modifying orifice to cause rotation of the runner* in a direction opposite and as a result of the reaction to, the fluid discharge.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 25, for a similar reaction jet discharge runner* with means to control flow of working fluid* through the internal working fluid passage by automatic, centrifugally actuated or torque responsive, means.
- 63, for a similar runner* with another runner* of the same or different type moving independently on the same or a different shaft*.

SEE OR SEARCH CLASS:

- 239, Fluid Sprinkling, Spraying, and Diffusing, subclasses 251+ for similar-type reaction devices for sprinkling, spraying or diffusing the discharged fluid into the ambient atmosphere, unless reversing is disclosed and see section IV, Class 239 for further statement of the line.

- 81** This subclass is indented under subclass 80. Apparatus comprising a set of blades* mounted on the runner* and acted upon by the fluid discharging from the orifice.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 63, for apparatus comprising a reaction-type runner* and a set of fluid impingement blades* in an arrangement which includes a plurality of runners* mounted for movement relative to each other or on separate

- shafts* for movement independent of each other.
- 82** This subclass is indented under subclass 80. Apparatus including a means to vary selectively the direction, or rate of movement of the runner*.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
 25, for a similar runner* and a centrifugally automatically or torque actuated, member for the control of the working fluid* and therefore the rate of movement of the runner*.
- 83** This subclass is indented under the class definition. Apparatus comprising a runner* having thereon a plurality of series or rows of blades* or passages, the plurality all lying on a common plane transverse to the runner* axis and having a common center and each series or row being on a radius different from the next adjacent series.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
 64, for a similar runner* in combination with another runner* of the same or different type and moving independently on the same or another shaft*.
 77+, for a runner* having a plurality of concentric annular series of blades*, the working fluid* flowing along the blades* in a direction parallel to the axis of the support member, the blades* extending radially inward and outward from a common ring member.
- 84** This subclass is indented under subclass 83. Apparatus comprising a series of blades* on the peripheral edge of the runner*.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
 62, for plural runners* supported for relative motion or on different shafts* in which there maybe a radial flow blade* system and an axial flow peripheral blade* system.
- 85** This subclass is indented under subclass 83. Apparatus having a means by which the direction or rotation of the runner* may be changed.
- 86** This subclass is indented under subclass 83. Apparatus comprising blades* projecting axially from the radial side wall extending inward of the peripheral rim of more than one runner* or from more than one side wall of a single runner inward from its peripheral rim.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
 62, 64 and 65, for plural runners* mounted for independent or relative motion and having similarly extending blades*, with or without the blades* of one runner* interleaving with those of another.
- 87** This subclass is indented under subclass 86. Apparatus in which the blades* extend axially from both sides of a common wall.
- 88** This subclass is indented under the class definition. Apparatus comprising a driven revolving runner* of tubular construction and having an open end which may be of funnel shape, submerged below the surface of a body of liquid.
- 89** This subclass is indented under the class definition. Apparatus comprising a driven rotating runner* comprising a hollow rotating fluid receptacle (e.g. drum, cylinder) having an inlet port or passage at or near its axis of rotation and an outlet port in its peripheral wall, the rotary motion of said receptacle causing the fluid to be inducted through the inlet port or passage into the interior of the receptacle and to leave said receptacle through the outlet port.
- SEE OR SEARCH CLASS:
 494, Imperforate Bowl: Centrifugal Separators, appropriate subclasses, for apparatus and process for breaking up a mixture of fluids or fluent substances into two or more components by centrifuging within a generally solid-walled, receptacle-like member.
- 90** This subclass is indented under the class definition. Apparatus comprising a runner* wall having an even, substantially uninterrupted or

bladeless* surface over which the working fluid* flows, the friction of the contact layer between the runner* and the fluid being the only cause of motion of the runner* or of the fluid.

SEE OR SEARCH CLASS:

198, Conveyors: Power-Driven, subclass 643, for an endless belt or chain-like member adapted to lift a viscous fluid from a body thereof as a result of the property of the fluid to adhere to the member.

416, Fluid Reaction Surfaces (i.e., Impellers), subclass 4 or a rotary skin friction-type rotor having a smooth substantially uninterrupted skin surface which contacts fluid such that reaction between the rotor and the fluid occurs solely as a result of friction, in the absence of a claimed casing* or other fluid distributing means*.

91 This subclass is indented under the class definition. Apparatus comprising a runner* of annular form, having a blade* on the inner periphery of the annulus and extending inwardly radially.

(1) Note. Included herein are arrangements wherein the runner* surrounds the casing*.

SEE OR SEARCH THIS CLASS, SUBCLASS:

88, for a pump* runner* having a rotating inlet end immersed in the fluid to be pumped and which may comprise a rotating annulus with inwardly radially extending blade*.

89, for a centrifugal bowl pump comprising a rotating runner* bowl like form with inwardly radially extending blade*.

SEE OR SEARCH CLASS:

416, Fluid Reaction Surfaces (i.e., Impellers), subclass 195 for a runner member comprising a peripheral rim connecting working members.

92 This subclass is indented under the class definition. Apparatus in which a runner* is caused to rotate by action of working fluid* thereon

comprising a cavity or chamber in the runner* fully closed or bounded by walls (runner* or casing*) and trapping working fluid* delivered thereto until the pocket registers with an exhaust conduit to discharge the working fluid* therefrom.

SEE OR SEARCH CLASS:

60, Power Plants, subclass 39.44 for a turbine of this type included in a power plant there classified.

93 This subclass is indented under the class definition. Apparatus comprising an arrangement whereby the working fluid* enters or leaves the runner* member or members in a plurality of axially directed paths, at least two of such paths being towards each other or away from each other, in order that the force of fluid acting in an axial direction on the runner* be balanced or neutralized, at least in part, by the force of fluid acting in the opposite axial direction.

SEE OR SEARCH THIS CLASS, SUBCLASS:

77+, for devices in which the working fluid* travels axially along one set of blades* attached to a peripheral wall and may then return in the opposite direction along blades* attached to the opposite side of the same peripheral wall.

SEE OR SEARCH CLASS:

416, Fluid Reaction Surfaces (i.e., Impellers), subclass 199 for a fluid reaction surface (e.g., Impeller or runner) which comprises multiple axially spaced working members or blades and a radially extending plate or deflector which causes the working fluid to enter or leave the working members in axially opposed paths.

94 This subclass is indented under subclass 93. Apparatus comprising a means whereby the amount or direction of the working fluid* may be selectively changed or adjusted.

95 This subclass is indented under subclass 94. Apparatus in which the apparatus is a motor*.

- 96** This subclass is indented under subclass 93. Apparatus comprising an additional member connected to and moving with the runner* support, which member includes an area exposed and subjected to the force imposed by a fluid and acting to balance or neutralize, at least in part, the axial thrust transmitted to the runner* support by the force of the working fluid* acting on a runner*.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
104+, for devices having shaft* connected surfaces subject to a fluid force to balance or neutralize end thrust, these devices not having axially opposed fluid paths to or from a runner* member or members.
- 97** This subclass is indented under subclass 93. Apparatus in which the runner* member is moved by a force and acts to increase the velocity, head or pressure of a fluid on which the runner* acts.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
120, for a pump* runner* in which the working fluid* enters radially and discharges axially.
- 98** This subclass is indented under subclass 97. Apparatus in which the runner* member comprises a substantially transverse radially extending wall encircling the shaft* and having one each side thereof a plurality of blades* which project in opposed directions along the axis.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
77+, for a runner* comprising an axially extending circular wall encircling the runner*, shaft*, said wall having runner* blades* extending radially from each side thereof.
- 99** This subclass is indented under subclass 97. Apparatus comprising two or more runner* members secured to a driven shaft*, each member in a separate radial plane through the shaft*.
- 100** This subclass is indented under subclass 99. Apparatus in which the fluid is directed in succession through two or more runner* members.
- 101** This subclass is indented under subclass 93. Apparatus in which the fluid is divided into at least two separate and distinct streams, each of which moves along and acts on the runner* member or members at the same time as the other.
- 102** This subclass is indented under subclass 101. Apparatus in which the fluid streams flow in axial paths that are directed towards each other and a single discharge opening, the streams combining in the discharge.
- 103** This subclass is indented under subclass 101. Apparatus in which each fluid stream traverses or impinges a plurality of blades* spaces in a direction along the axis.
- 104** This subclass is indented under the class definition. Apparatus comprising a member whose area is exposed and subjected to a fluid* force and so associated with a runner* support that the said force tends to balance and neutralize, at least partly, the axis thrust developed by the working fluid* on the supported runner*.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
96, for similar devices having similar balancing surfaces acted upon by a fluid however, also having axially opposed fluid* paths to or from the runner* means, the fluid* paths also acting to counterbalance end thrust.
- 105** This subclass is indented under subclass 104. Apparatus in which the member is positioned in a chamber into which a fluid, separate and apart from that used as the working fluid*, is admitted.
- 106** This subclass is indented under subclass 104. Apparatus in which there is a fluid force acting in an axial direction on one side of a member, a blade* being supported on the other side of the member.
- (1) Note. Subject matter under this definition typically includes radial flow-type

runners* in which there are passages to communicate fluid to the rear side of the transverse blade* support disc to balance axial thrust acting on the front side of the disc.

- (2) Note. Excluded under this definition is a runner* having a blade* on each side of a common wall or shroud plate, for which search subclass 198.1, unless a port transfers fluid from one side of the wall or plate to the other.
- (3) Note. To qualify under this definition, there must be provided means for conveying the fluid to the rear side of the runner*, e.g., a port conduit or axially moving runner*; the mere presence of leakage fluid on the rear side of the runner*, even though disclosed for thrust balancing, is excluded under this definition.

107 This subclass is indented under subclass 104. Apparatus in which the runner* support is that in a fluid motor*.

108 This subclass is indented under the class definition. Apparatus comprising a casing* and a shell or cover, the latter surrounding and spaced from the casing*, the working fluid* having access to the space between the casing* and shell.

- (1) Note. Typically the space between the casing* and shell permits thermal expansion of parts of the apparatus or heat exchange between the working fluid* in the space and parts of the apparatus.

109 This subclass is indented under the class definition. Apparatus comprising a chamber into which the shaft* extends and which is substantially sealed around the shaft* and which contains a fluid acting to prevent leakage of fluid along the shaft*, there being an abutment surface connected to and rotating with the shaft* and serving to maintain the sealing fluid in the chamber in motion.

SEE OR SEARCH CLASS:

277, Seal for a Joint or Juncture, for a generic sealing means or process (e.g., seal between a runner* and

another relatively movable part, seal between the two relatively moving members, does not recite enough details of the rotary kinetic device, etc.), subclasses 427+ for a dynamic close proximity seal (e.g., contactless, fluent, etc.) having an impeller or another rotating member to form a centrifugal liquid barrier.

110 This subclass is indented under the class definition. Apparatus comprising a fluid path between the normal working fluid* path and the interior part of an assembly which is positioned between two relatively moving apparatus parts (e.g., casing*, shaft*) the assembly service to (1) reduce or prevent unwanted working fluid* leakage between the parts, or (2) reduce the friction between the parts.

- (1) Note. If the fluid path originates outside of the system or with a nonsystem fluid, it must discharge into the working fluid* path; if the working fluid* is the source for the seal, packing, lubricating or bearing assembly, it may then discharge outside of the system.

SEE OR SEARCH THIS CLASS, SUBCLASS:

142, 170.1+ and 229+, for other types of bearing or seals but not having a connection with the working fluid* path.

SEE OR SEARCH CLASS:

74, Machine Element or Mechanism, subclasses 5+ for runners supported in bearings for gyroscopic action and for a statement of the line see reference to Class 74 in section IV of the Main Class Definition of Class 415.

277, Seal for a Joint or Juncture, for a generic sealing means or process (e.g., seal between a runner* and another relatively movable part, seal between the two relatively moving members, does not recite enough details of the rotary kinetic device, etc.), subclasses 345+ for a seal between relatively movable parts (i.e., a dynamic seal).

- 111** This subclass is indented under subclass 110. Apparatus in which the assembly is positioned between the runner* support member (shaft*) and a relatively fixed member.
- (1) Note. Excluded under this definition is a conduit merely returning fluid which has leaked past a seal, bearing or packing to the working fluid*; such devices will be found in subclasses 168.1+ and 169.1+.
- 112** This subclass is indented under subclass 111. Apparatus in which the assembly is provided with two openings, one providing for ingress and the other for egress of the fluid.
- 113** This subclass is indented under subclass 111. Apparatus in which the assembly is provided with a part which is (1) acted upon and movable towards an extreme position by the force exerted by a fluid, (2) supported for movement to any of a plurality of selected positions, or (3) made of a yielding material which can regain its original shape after being deformed.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 132, for a movable bearing on which an end of the shaft* is supported and which serves to axially adjust the shaft*.
- 114** This subclass is indented under the class definition. Apparatus comprising means for transferring heat to or from an apparatus part which means includes a container for a medium which is capable of changing its physical state from or to solid, liquid or gas and in so changing transfers heat between itself and the apparatus part.
- 115** This subclass is indented under the class definition. Apparatus comprising a fluid connection between the working fluid* path and a fluid conducting path in a runner* blade*, a stator vane*, the runner* support (shaft*) or a member turning in the working fluid* path and discharging fluid across substantially the entire area of the working fluid* path.
- (1) Note. The fluid* path in the blade*, vane*, shaft* or rotary member may be connected to a source of nonsystem fluid for passage into the working fluid* path.
- (2) Note. The fluid circuit may be for any purpose; included are devices for boundary layer control or for heating or cooling a runner* blade* or stator vane*.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 116, for a device comprising a diversely oriented inlet or an additional inlet for diverse fluid, which may be for cooling fluid.
- 180, for a device in which cooling fluid contacts the exterior of a shaft*, seal or bearing.
- 914, for a device including means to control a working fluid boundary layer.
- 116** This subclass is indented under the class definition. Apparatus provided with (1) means to admit a fluid differing from the working fluid* in some essential characteristic (e.g., temperature, pressure, composition), or (2) at least two inlet means admitting the same working fluid* into the apparatus, one inlet means different from the other in some essential characteristic, (e.g., size, attitude or position relative to a fixed point or axis).
- (1) Note. In order to qualify under this definition, the diverse inlets or the diverse fluid must enter the apparatus upstream of all disclosed runner* stages.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 115, for means including a passage in a runner* blade, stator, vane*, shaft* or rotary distributor for adding either working fluid* or a diverse fluid to the working fluid*.
- 144+, for a device in which one of a plurality of diverse fluid is caused to enter downstream of the initial runner* stage.
- 117** This subclass is indented under subclass 116. Apparatus comprising a motor* to which a plurality of diverse fluids are admitted upstream of all the disclosed runner* stages.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

180, for a device in which a diverse fluid cools the shaft*, seal or bearing by contact and in which the diverse fluid does not impinge on any of the runner* stages.

- 118** This subclass is indented under the class definition. Apparatus comprising means other than fixed exhibitors (e.g., signs) which determine, or give information about, a condition or characteristic of the apparatus, or permit viewing of a condition or extent of motion of the apparatus or a part thereof.

SEE OR SEARCH CLASS:

73, Measuring and Testing, subclasses 861.79+ for the subcombination of a rotary motor directly connected to a registering or indicating means and see the Class Definition, References to Other Classes, above, for the reference to Class 73 for a statement of the line.

116, Signals and Indicators, appropriate subclasses, for a mechanical device for giving a signal of the nature of either an alarm or an indicator.

340, Communications: Electrical, appropriate subclasses, for an electrical signal, per se.

- 119** This subclass is indented under the class definition. Apparatus comprising means or a disposition of parts to eliminate, reduce or prevent the formation or transmission of sonic or oscillatory waves from the apparatus to the environment or between parts of the apparatus.

- (1) Note. Examples of such means are: sound traps, nozzle shapes, absorbent material.

SEE OR SEARCH CLASS:

60, Power Plants, appropriate subclasses, for a fluid motor* combined with means treating or handling the exhaust fluid for absorbing or damping sound or vibratory waves, see the Class Definition, References to Other Classes, above, Class 60, Power Plants, (8).

181, Acoustics, subclasses 200+ for the sound muffler or sound filter subcombination, per se.

- 120** This subclass is indented under the class definition. Apparatus comprising a pump* in which the working fluid* initially enters the casing* at the periphery and is discharged through a central opening in an axial direction, the runner* forcing the working fluid towards the center of the axis of rotation.

- (1) Note. In order for a multistage pump* to be included under this definition the working fluid* must, in at least one stage, enter the periphery of the runner* and leave at or near the center.

121.1 WITH CUTTER OR COMMUNUTOR FOR DEBRIS IN WORKING FLUID:

This subclass is indented under the class definition. Device comprising means to chop, sever, grind, or otherwise pulverize or reduce in size, elements carried along by the working fluid*.

- (1) Note. The means usually acts on the elements to avert jamming of the device by the elements.
- (2) Note. The means may include part of a runner* or runner blade*.

SEE OR SEARCH CLASS:

241, Solid Material Comminution or Disintegration, appropriate subclasses, for a rotary pump* with comminuting structure which is separate and distinct from the pump runner and the surrounding casing*, such as subclass 46.012, for a comminutor in a dishwasher pump, or subclass 185.6, for a rotary striking member type comminutor with a pump. Refer to the Class 415 Definition line notes for further explanation of class lines.

121.2 WITH SEPARATING MEANS OR GUARD FOR SOLID MATTER IN WORKING FLUID (E.G., DEBRIS, ETC.):

This subclass is indented under the class definition. Device comprising (a) means to divide out solid elements carried along by the working fluid* from the working fluid or (b) means to shield or protect part of the device from solid

elements in or carried along by the working fluid.

- (1) Note. Elements carried along by the working fluid which are separated from the working fluid may include dust, sand, pieces of the device which have entered the working fluid as a result of structural failure, etc.
- (2) Note. A means which shields a part of the device from human hands is included in this subclass.
- (3) Note. A means which merely separates moisture or condensate from working fluid in the device is not included in this subclass.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 9, for a device having a destructible, nonreusable part which may cause debris to enter the working fluid and further having means to guard the device against such debris.
- 169.1+, for a device including means for handling a portion separated from the working fluid, particularly subclasses 169.2+ wherein moisture or liquid is separated from a gaseous working fluid (e.g., condensate removal).

SEE OR SEARCH CLASS:

- 416, Fluid Reaction Surfaces (i.e., Impellers), subclass 247 for an impeller having a protective screen or guard.

121.3 COMBINED:

This subclass is indented under the class definition. Device comprising a runner* in combination with features not provided for above or in any other subclass, such features excluding means for the device's associated working fluid* distribution or control, casing* or housing structure, motion transmitting structure to or from the runner and its support shaft*, packing, bearing, or sealing assembly structure, and heat exchanging structure.

- (1) Note. Examples of combined features include: an art device (other than a conducting means for the working fluid) serving as a support means or otherwise

associated with the apparatus, a portable torque, a well packer or plug sealing the outside of a pump* casing to a surrounding conduit, etc.

- (2) Note. See the main class definition for lines between this and other classes in regard to certain combined features.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 122.1+, for a device comprising specific shaft* transmission train, brake, clutch, or attendant actuated drive means.
- 169.1+, for a device including means for handling a portion separated from the working fluid, particularly subclass 169.2 wherein moisture or liquid is separated from a gaseous working fluid (e.g., condensate removal, etc.).

SEE OR SEARCH CLASS:

- 166, Wells, appropriate subclasses, especially subclass 101, 118+, 141, 142+, and 173 for the subcombination of a packer, an expanding anchor or a well screen. For a more detailed statement of the line, see the class definition of Class 166, Wells.
- 416, Fluid Reaction Surfaces (i.e., Impellers), subclass 5 for illumination means combined with a runner where no confining or directing means for the fluid is claimed.

122.1 INCLUDING SHAFT TRANSMISSION TRAIN, BRAKE, CLUTCH, OR ATTENDANT ACTUATED DRIVE MEANS:

This subclass is indented under the class definition. Device comprising (a) means to transmit motion between a runner* or runner shaft* and a driven or driving shaft and including means for causing or permitting relative motion or speed between the runner or runner shaft and the driven or driving shaft, (b) means to retard, stop, or prevent movement of a runner or its shaft, (c) means to connect or disconnect a runner or runner shaft with a driven or driving shaft, or (d) means operated by a human or animal to cause movement of a runner.

- (1) Note. Excluded under this definition are means whereby the motion between the

shafts is transmitted without the possibility of relative motion. Thus a flanged coupling is not included, but a flexible cone, spit pulley, belt gearing, universal joint coupling, and other such similar couplings or trains are included.

- (2) Note. Excluded under this definition is a mere shiftable nozzle or pipe for discharging a working fluid* onto the runner. To qualify under this definition, the means for braking must be in addition to the means discharging working fluid onto the runner.

- 123** This subclass is indented under subclass 122.1. Apparatus comprising means to (1) connect or disconnect the runner* supporting shaft* to a driven or driving shaft* or (2) retard, stop, or prevent movement of the runner* or its supporting shaft*.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 18, for clutch or brake devices which are controlled by means responsive to non-cyclic condition sensing, centrifugal actuation, or torque.
- 61, for plural runners* mounted for relative or independent movement and means, which may be a clutch means, for connecting a runner* to the shaft*.

SEE OR SEARCH CLASS:

- 477, Interrelated Power Delivery Controls, Including Engine Control, for interrelated control between a motor* and a transmission, clutch, or brake.

- 124** This subclass is indented under subclass 122.1. Apparatus in which a human or an animal actuates (1) an arm bent or keyed at right angles to a shaft to impart motion thereto, (2) a treadle connected to and imparting motion to a shaft, or (3) a ground engaging rotating member connected to and imparting motion to a shaft, the shaft in all cases ultimately imparting motion to the runner* shaft*.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 5, for an endless flexible member such as a chain on which there is mounted a blade* or a surface which acts like a

blade* to pump* fluid, the chain operated by a human or an animal.

124.1 Runner supported portion engages shaft transmission train (e.g., peripheral gear drive, etc.):

This subclass is indented under subclass 122.1. Device comprising a means to transmit motion between a runner* and a driven or driving shaft which means causes or permits relative motion or speed between the runner and the shaft. The means includes a motion transmitting element which is carried on the runner.

- (1) Note. A runner shaft is not considered to be a portion of the runner for purposes of this subclass. Thus, a shaft transmission train which merely incorporates a motion transmitting gear which is carried on a shaft* which supports the runner for rotation is not included in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 91, for a device having an annular runner* with an inwardly projecting blade* which may include peripheral gear drive means.

124.2 Shaft transmission train having flexible means or coupling:

This subclass is indented under subclass 122.1. Device comprising means to transmit motion between a runner* and a driven or driving shaft* which means causes or permits relative motion or speed between the runner and the shaft. The means includes (a) a motion transmitting means which, by design, bends or otherwise exhibits nonrigid properties or (b) a driving connection between two motion transmitting elements of the means which allows nonrigid movement of the two elements relative to one another (i.e., a fixed movement of one element does not continuously correspond to a fixed movement of the other element).

- (1) Note. A device wherein the means to transmit motion comprises a motion transmitting shaft which is coupled to another motion transmitting shaft by a flexible joint (e.g., U-Joint) is included in this subclass.

- (2) Note. A friction, fluid, or magnetic coupling which connects two motion transmitting elements nonrigidly is included in this subclass provided the coupling does not serve to connect and disconnect the two motion transmitting means. The latter coupling type is a clutch (see subclass 123).
- (3) Note. A driving connection between two motion transmitting elements which permits nondrive related movement between the elements is included in this subclass (e.g., two intermeshing gears rotating about parallel axes which are permitted to move axially relative to each other without affecting the drive relationship).
- (4) Note. A motion transmitting means comprising two conventional gears in direct driving relationship is not included in this subclass.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
123, for a device having means to connect and disconnect the runner supporting shaft with the driven or driving shaft.
- 125** This subclass is indented under the class definition. Apparatus having a means to impart regularly recurring movement to an element of the apparatus.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
141, for a runner* blade* portion which is pivotally mounted for regularly occurring self-feathering motion.
- 126** This subclass is indented under the class definition. Apparatus comprising means for positively and at will holding the runner* enclosing housing, or a part thereof, in a selected one of a plurality of different positions in relation to a means on which the apparatus is sustained.
- (1) Note. The sustaining or supporting means for the apparatus need not be claimed for this and the indented subclasses, if it is clear from the disclosure that the adjustment is relative to such a sustaining means.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
14, for control means responsive to the position of a casing*, runner* or shaft*.
- 127** This subclass is indented under subclass 126. Apparatus in which the runner* enclosing housing may be moved about an axis coincident with the runner* axis in order to position the inlet or outlet in any of a plurality of different angular positions.
- 128** This subclass is indented under subclass 126. Apparatus in which the member moved is on the inner periphery of the housing, such member being in addition to the normal wall of which the housing is comprised.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
196, for a nonadjustable casing casing* liner.
- 129** This subclass is indented under the class definition. Apparatus comprising means for positively and at will holding the runner* or a blade* in a selected one of a plurality of different positions in relation to the runner* enclosing housing during operation.
- (1) Note. Included under this definition is means to axially move the shaft* on which a runner* is fixedly secured.
- 130** This subclass is indented under subclass 129. Apparatus comprising a plurality of runners*, or a plurality of blades* on a single runner*, each member of such plurality movable selectively to different positions around an axis with respect to the remaining members, and retained in any of the positions.
- 131** This subclass is indented under subclass 129. Apparatus in which the runner* or blade* is moved along the axis to its new position.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
34, for devices in which the shaft* or bearing is adjusted along the runner

- axis by automatic speed or torque responsive means.
- 132** This subclass is indented under subclass 131. Apparatus in which an end of the runner* support shaft* is supported on a member on which it turns or revolves and the member may be adjusted to move the shaft* axially.
- 133** This subclass is indented under subclass 129. Apparatus comprising means to move the runner* shaft* along a plane transverse to the axis.
- (1) Note. Typically, this subclass includes bearings supporting the shaft* with means to adjust the bearings radially, the bearings carrying the shaft* to the adjusted position.
- 134** This subclass is indented under the class definition. Apparatus in which two or more apparatus parts are joined by means which allow at least one of said parts at the location of the joint to move in a selected direction (i.e., expand or contract) as a result of temperature change without being twisted or bent from its normal shape.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 35, for devices having a housing spaced from the casing*, the space open to working fluid, the housing and casing usually being free to move relative to one another as a result of temperature changes.
- 135** This subclass is indented under subclass 134. Apparatus in which the means comprises a member which may be deformed and which thereafter tends to return to its normal shape and size when the deforming stress is removed.
- (1) Note. Most of the patents under this definition include a spring or similar elastic member backing up a part subject to thermal expansion so that such expansion is taken up by the spring.
- 136** This subclass is indented under subclass 134. Apparatus in which the selected direction is transverse to the axis of the runner* shaft*.
- 137** This subclass is indented under subclass 136. Apparatus comprising an inner annulus, an outer annulus of greater radius, with a vane* fixed to one annulus and extending radially to the other, there being a complementary opening provided in the other annulus, through which the end of the vane* moves on expansion or contraction due to temperature changes.
- 138** This subclass is indented under subclass 136. Apparatus in which movement may also occur in a direction parallel to the axis of the runner* shaft* or angularly around such axis.
- 139** This subclass is indented under subclass 134. Apparatus comprising a plurality of portions of fluid directing members, said portions extending angularly around and radially spaced from the axis of the runner* support member, said portions having their edges normally spaced from each other whereby dimensional changes due to temperature changes cause such edges to approach or retreat towards or away from each other along the periphery.
- 140** This subclass is indented under the class definition. Apparatus comprising (1) a blade* or a portion thereof which is formed or mounted so as to move relative to its support or a fixed position, (2) the runner* or its shaft* mounted to move in a direction parallel to the axis of rotation from one position to another, while in use and without the intervention of a human attendant.
- (1) Note. Examples of devices included under this definition are: one which is buoyed up by the working fluid* (usually water acting on a surface associated with a turbine) to reduce friction on the lower step bearing, one in which a portion of the blade* has a fluid operated valve thereon and one in which the blade* is regularly and cyclically self-feathering.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 106, for a device in which the runner* is mounted for slight axial movement to vary flow into and out of balancing chamber to neutralize end thrust on the shaft*.

- 125, for a device having means to impart regular and cyclical movement to a blade*.
- 126+, for devices in which there are means provided to positively selectively move or hold in a selected position the blade*, runner* of shaft*.
- 129+, for a device having means for positively and selectively moving a runner* or runner supporting shaft*.
- 141** This subclass is indented under subclass 140. Apparatus comprising a blade* having a resilient connection to its support or having a pivot intermediate its length or formed of resilient material.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 125, for a device having means to impart regularly recurring movement to a blade* or a portion thereof.
- 142** This subclass is indented under the class definition. Apparatus comprising a runner* supporting shaft* within and spaced from a casing* and having a member in which the shaft* turns or revolves and is supported, there being legs or other supports extending between the member and the casing* wall.
- (1) Note. Some of the legs or other support members may act to guide or direct the fluid.
- 143** This subclass is indented under the class definition. Apparatus comprising two or more separate and distinct runner* members, the working fluid* passing through one of the runners* in a path of a distinctly different type than the path it assumes in passing through another of said runners* (e.g., axial and centrifugal working fluid* paths).
- (1) Note. The separate and distinct runner* member must be removed as a recognizable runner* subassembly handled as a unit during assembly of the whole device, leaving the other runner* to function as usual. A centrifugal impeller, for example, having blades* which are formed to provide for flow in another path, but which blades* cannot be removed unless destroyed, is excluded under this definition.
- (2) Note. Centrifugal and Centripetal flows are considered to be the same type of flow path under this definition.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 62, for an apparatus comprising plural runners* mounted for independent or relative movement and in which there are at least two distinctly different runners*, arrangements of blades* or directions of the working fluid* flow paths.
- 144** This subclass is indented under the class definition. Apparatus comprising a path for a portion of the working fluid* from the inlet upstream of the runner* through the apparatus, which path includes less than all of the blade* row on the runner* (i.e., less than all runner* stages).
- (1) Note. In order to qualify under this definition, there must be means specifically provided to cause the bypass a device having a path for working fluid* which has leaked past a joint and does not include all of the runner* stages is not classified in this group of subclasses, but will be found in subclass 168.1.
- (2) Note. Included under this definition is a device comprising a plurality of runner* stages and (1) a plurality of diverse working fluids*, one of which is caused to enter at an intermediate stage, or (2) a single working fluid*, at least a portion of which is discharged at an intermediate stage.
- (3) Note. Included under this definition is a pump* comprising a plurality of blade* sets, a separate portion of the working fluid* impinging on each set and discharging separately from the other portion and at a different pressure.
- (4) Note. Included under this definition is a device in which a portion of the working fluid* bypasses completely all of the runner* stages and is combined in the

outlet conduit with the working fluid* which has impinged on the runner.

- (5) Note. Included under this definition is a device having a pressure relief valve in an intermediate stage for exit of working fluid*.
- (6) Note. Included under this definition is a device in which working fluid* in passing to a lower runner* stage, is caused to stratify and only one layer is passed to the lower runner* stage, or both layers act on a plurality of runner* stages in parallel.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 61, for plural runners* mounted for independent or relative movement and means to bypass at least one of the runners*.
- 115, for a device in which working fluid* is bypassed around at least one runner* blade row by means of a passage in a vane*, blade*, shaft* or rotary distributor.
- 116+, for a device in which a plurality of diverse fluids or a plurality of diverse inlets enter the apparatus upstream of all disclosed runner* stages.

- 145** This subclass is indented under subclass 144. Apparatus comprising a movable regulating or distributing means* for selecting the quantity of working fluid* in the path including less than all the blade* rows.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 28, for a valve bypassing a runner* stage, the valve activated by an automatic control means.

- 146** This subclass is indented under the class definition. Apparatus comprising a member in the working fluid* flow conduit which member guides or regulated the flow of working fluid* and is movable from a first position towards a second position by a force caused by the flow of working fluid* acting against the member and is biased or otherwise urged towards its first position when the working fluid* stops flowing or the direction of its flow reverses.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 2.1+, for a device with means for controlling casing* or flow guiding means in response to natural fluid current force or direction (i.e., water or wind current).

SEE OR SEARCH CLASS:

- 137, Fluid Handling, subclasses 455+ for line condition responsive valves and particularly subclasses 511+ for other check type or return flow preventing valves.

- 147** This subclass is indented under subclass 146. Apparatus in which the member is followed by the runner* in the direction of fluid flow.

- 148** This subclass is indented under the class definition. Apparatus comprising a vane* or other control means which may be selectively moved to different positions to vary the direction or amount of working fluid* flow.

- (1) Note. This group of subclasses will accept a claim which must be classified in this class, even though the runner* is not recited.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 8, for a device comprising a driven runner* immersed in a fluid and an adjustable vane* in an unconfined fluid stream for selectively guiding the working fluid*.
- 53.3, for a device having a cross flow runner* and further including selectively adjustable vane* or working fluid* control means.

SEE OR SEARCH CLASS:

- 138, Pipes and Tubular Conduits, subclasses 37+ for a fluid conduit having baffles or other means for changing the direction or rate of flow of fluid in the conduit.

251, Valves and Valve Actuation, appropriate subclasses for fluid flow controlling valves, particularly subclasses 118+ for fluid handling devices with baffles or other material guide structure.

416, Fluid Reaction Surfaces (i.e., Impellers), appropriate subclasses, for a runner* and continuously moving vanes* or deflectors with no fixed means to direct or confine the working fluid*.

149.1 Separate means upstream and downstream of blade set:

This subclass is indented under subclass 148. Device comprising two such vanes* or other control means, one such vane or other control means directing the working fluid* onto a row of runner* blades* and a second such vane or other control means receiving working fluid from the same row or a different row of runner blades.

- (1) Note. The two means need not be positioned adjacently upstream and downstream of one row of runner blades.
- (2) Note. This subclass does not include a device merely comprising a single vane, vane row, or other control means which (a) directs the working fluid onto a row of runner blades when the working fluid is flowing through the device in one direction and (b) receives the working fluid from the row of runner blades when the working fluid is flowing through the device in an opposite direction.

SEE OR SEARCH THIS CLASS, SUBCLASS:

151+, for a device having a selectively adjustable vane or working fluid control means located upstream of the runner.

149.2 Including axial flow blade set:

This subclass is indented under subclass 149.1. Device wherein the working fluid* path to, through, and from one of the rows of runner blades is in a direction predominantly parallel to the runner's rotational axis.

149.3 Means to reverse flow through blade set:

This subclass is indented under subclass 149.2. Device comprising means to alter the flow of working fluid* to, through, and from the one (axial flow) row of runner blades to be in either of opposite directions.

SEE OR SEARCH THIS CLASS, SUBCLASS:

910, for a device reversible between pump and motor use.

149.4 Plural, selectively adjustable, alternating vane assemblies and axial blade rows (A, B, A, B):

This subclass is indented under subclass 149.2. Device comprising (a) at least two rows of such (axial flow) working member blades* which rows contact the working fluid* sequentially and (b) at least two rows of such (selectively adjustable) static partition members (vanes*). The blade (A) and static partition member (B) rows are configured to contact the working fluid by turns ("A, B, A, B" or "B, A, B, A") as the working fluid passes through the device.

- (1) Note. The working member blade rows need not be claimed for inclusion in this subclass provided it is understood that the rows are present in the described configuration.

SEE OR SEARCH THIS CLASS, SUBCLASS:

199.5, for plural, serial, axial flow blade sets with one or more nonselectively adjustable intermediate stationary flow diverters.

150 This subclass is indented under subclass 148. Apparatus in which the vane* or other means is moved by the runner*, the shaft* or a separate and independent source of power.

SEE OR SEARCH THIS CLASS, SUBCLASS:

42+, for a vane* or valve controlling the working fluid* and actuated by the runner*, a separate motor* or the shaft* and in response to a predetermined speed.

- 125, for a device in which an apparatus part is given a regularly recurring motion.
- 151** This subclass is indented under subclass 148. Apparatus in which the vane* or other means is positioned ahead of at least one blade* row of a runner* in relation to the direction of flow of working fluid*.
- (1) Note. The working fluid* may contact one or more blade* rows before it contacts the vane* or other means.
- 152.1 Motor runner with selective inlet paths for reversible rotation:**
This subclass is indented under subclass 151. Device wherein working fluid* adds energy to and rotates the runner* (i.e., "motor*" runner). The vane* or other (control) means varies the route of working fluid flow to the runner to rotate the runner unidirectionally in one direction when the vane or other (control) means is in one position and to rotate the runner unidirectionally in an opposite direction when the vane or other (control) means is in another position.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 61, for a device having means controlling working fluid to one of a plurality of runners which are on separate shafts* or mounted for relative rotation.
- 82, for a motor runner device motivated by a reaction-type jet discharge nozzle from an internal working fluid conduit which has means for controlling the runner directions.
- 85, for a device having a runner with annular blade rows or fluid channels spaced on a common radial plane which has means for reversing the runner's rotation.
- 167, for a device with a movable working fluid pipe or nozzle which is capable of directing working fluid to a runner from various directions.
- 910, for a device reversible between pump and motor use which may have means for reversible rotation of the runner.
- 911, for a device comprising a reversible pump runner and separate outlets for opposing directions of rotation.
- 152.2 Runner includes radial flow blade set:**
This subclass is indented under subclass 152.1. Device comprising a runner* having a blade* row wherein the working fluid* flow path through the blade* row is predominantly inwardly toward or outwardly from the runner's axis of rotation.
- (1) Note. A circumferential flow blade row is not considered to be a radial flow blade row for the purposes of this subclass.
- 153.1 Separate runner blade set acted upon for reverse rotation:**
This subclass is indented under subclass 152.1. Device wherein the runner* comprises at least two blade* rows. The (selectively adjustable) vane* or other (control) means, when in one position, directs the working fluid* to one of the blade rows to rotate the runner unidirectionally in one direction and, when in another position, directs the working fluid* to a second of the blade rows to rotate the runner unidirectionally in an opposite direction.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 78, for a device comprising a runner having blades extending radially inward from a common annulus with means for selecting only one blade row for working fluid flow, usually for reversing runner rotation.
- 153.2 Axial flow blade set:**
This subclass is indented under subclass 153.1. Device wherein the working fluid* flow path to, through, and from one of the runner* blade* rows is predominantly parallel to the runner's axis of rotation.
- 154.1 Plural inlets simultaneously discharging working fluid onto single blade set:**
This subclass is indented under subclass 152.1. Device wherein one of the working fluid* (selective inlet) paths to the runner* includes at least two apertures or nozzles through which the working fluid is directed concurrently onto a runner blade row.

154.2 Axial flow blade set:

This subclass is indented under subclass 154.1. Device wherein the working fluid* flow path to, through, and from the working member blade* row is predominantly parallel to the runner's axis of rotation.

154.3 Including axial flow blade set:

This subclass is indented under subclass 152.1. Device wherein the working fluid* flow path to, through, and from a working member blade* row of the runner* is predominantly parallel to the runner's axis of rotation.

155 This subclass is indented under subclass 151. Apparatus comprising two or more distinct and individually operable means, all of which are positioned upstream of the same blade* row.

- (1) Note. Excluded under this definition is a device having a plurality of adjustable vanes* or other working fluid* control means, which operate simultaneously, but each of which is so arranged as to yield independently of the others when obstructed. The only devices included under this definition are those where each of a plurality of vanes* or other working fluid* control means is selectively adjusted independently of the others.

156 This subclass is indented under subclass 151. Apparatus in which the means (1) comprise at least in part a material which is capable of being altered in shape and of returning or being returned to its original shape (e.g., elastic) or (2) is held in working position by means capable of recovering its original shape or position after being distorted or moved (e.g., spring).

157 This subclass is indented under subclass 151. Apparatus in which the means comprises a member of cylindrical or disklike configuration, shiftable along or in the direction of the runner* axis.

158 This subclass is indented under subclass 157. Apparatus in which the member is capable of being shifted to a position encircling or surrounding the runner*.

159 This subclass is indented under subclass 151. Apparatus comprising two or more means angularly spaced around and equidistant from the runner axis.

160 This subclass is indented under subclass 159. Apparatus in which each means comprises a vane* mounted for movement around its axis.

- (1) Note. In order to qualify under this definition, there must be some directing or guiding of the working fluid*. See definition of "vane" in section 1 of the Main Class Definition.

161 This subclass is indented under subclass 160. Apparatus comprising in addition, a vane* or other flow guiding member nonadjustably supported in the flow path.

162 This subclass is indented under subclass 160. Apparatus comprising two or more distinct sets of vanes*, all the vanes* in one set being simultaneously movable.

- (1) Note. A set of vanes* comprises at least two physically interrelated vanes*, usually in a single circular annulus and which together controls the working fluid* at a particular zone or area of the path. See (1) Note in subclass 52 for definition of a blade set.

- (2) Note. Each set of vanes* may control working fluid* flow to a distinct set of runner* blades*, or all sets of vanes* may control flow to a single set of runner* blades*.

163 This subclass is indented under subclass 160. Apparatus in which the pivot axis of each vane* is parallel to the runner* axis.

164 This subclass is indented under subclass 163. Apparatus in which the vanes* lie in a plane which is normal to the runner* axis and passes through at least part of the runner* blade*.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 45, for speed responsive means for controlling the flow of working fluid* to a runner* blade* through a plurality

of inlets which are located on the same radial plane as said blade*.

165 This subclass is indented under subclass 159. Apparatus in which the means lie in a plane which is normal to the runner* axis and passes through at least a portion of the runner* blade*.

- (1) Note. Included under this definition is a control means which is movable into and out of the same radial plane as the runner* blade*.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 45, for speed responsive means for controlling the flow of working fluid* to a runner* blade* through a plurality of inlets which are located on the same radial plane as said blade*.
- 164, for adjustable vanes* laying in the same radial plane as part of the blade*, each vane* having a pivot axis parallel to the runner* axis.

166 This subclass is indented under subclass 165. Apparatus in which the means are selectively rotatable about the runner* supporting axis.

167 This subclass is indented under subclass 151. Apparatus in which the means comprises a working fluid* conduit shiftable to a plurality of positions relative the the runner*, and having a modified or unmodified discharge outlet.

- (1) Note. The working fluid* conduit may be shiftable to positions wherein the working fluid* bypasses or reverses the direction of rotation of the runner*, or acts as a braking medium to slow the velocity of runner* rotation.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 123, for a device in which an additional nozzle or other means discharge working fluid* onto a runner* associated member for retarding or slowing the runner*.

SEE OR SEARCH CLASS:

- 239, Fluid Sprinkling, Spraying, and Diffusing, subclasses 587.1+ for a nozzle or general utility adjustably or

shiftable mounted relative to its support.

167.1 Convertible series-parallel pump:

This subclass is indented under subclass 151. Device comprising two blade* rows which each add energy (i.e., "pump"* blade rows) to working fluid* and further comprising means to selectively configure the device to direct the working fluid from a device inlet to an outlet either (a) along one path proceeding through the two blade rows in sequence (i.e., in-series flow path) or (b) along separate paths, a proceeding alone different ones of the through only one of the blade rows (i.e., in-parallel flow paths).

168.1 INCLUDING MEANS FOR HANDLING WORKING FLUID LEAKAGE:

This subclass is indented under the class definition. Device comprising means to treat, dispose of, or otherwise deal with a portion of the working fluid* which has passed through a flow preventing or retarding joint between two distinct elements of the device.

- (1) Note. Lubricating or other fluid not originating in the working fluid is not considered to be working fluid leakage under this definition.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 52.1+, for a device comprising reentry means for working fluid which has passed through a joint between two distinct elements of the device.
- 110+, for a device comprising a seal, packing, or bearing having an internal working fluid connection which carries off any leakage from the seal, packing, or bearing.
- 115, for a device comprising means to discharge leakage fluid into the working fluid path by means of a passage in a blade*, vane*, or shaft.
- 170.1+, for a device having a seal between a runner portion and a static part.

168.2 Leakage through seal between runner or shaft and static part:

This subclass is indented under subclass 168.1. Device wherein the working fluid* has passed through at least a portion of a structure which

prevents or retards the flow of working fluid between a runner* or shaft* and a fixed element (i.e., seal).

- (1) Note. The structure may be integral with the runner, shaft, or fixed element.

168.3 Screw type pumping seal:

This subclass is indented under subclass 168.2. Device wherein the (seal) structure comprises a helical groove located at the interface between the runner* or shaft* and the fixed element, which groove rotates relative to the runner or the fixed element to drive the working fluid* between the runner or shaft and the fixed element in a direction parallel to the runner's axis of rotation.

- (1) Note. The groove may be part of the runner or the fixed element.

168.4 Means specific to axial flow runner:

This subclass is indented under subclass 168.2. Device wherein particular significance is attributed to the runner* being of the type having working fluid* flow to, through, and from the runner predominantly parallel to the runner's axis of rotation.

169.1 INCLUDING MEANS FOR HANDLING PORTION SEPARATED FROM WORKING FLUID:

This subclass is indented under the class definition. Device comprising means to treat, dispose of, or otherwise deal with a part of the working fluid* which has been removed (i.e., separated) from the working fluid.

- (1) Note. The "part of the working fluid which has been removed from the working fluid" may comprise condensate, moisture, nonsolid particles suspended in the working fluid, a small quantity of the working fluid, etc.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 52.1+, for a device comprising means for directing a portion of working fluid back to a blade set previously contacted by the working fluid, particularly subclasses 56.1+ wherein the means is used to discharge air and prime a pump.

- 110+, for a device comprising a seal, packing, or bearing having an internal working fluid connection which carries off any leakage from the seal, packing, or bearing.

- 115, for a device comprising means to discharge leakage fluid into the working fluid path by means of a passage in a blade*, vane*, or shaft.

- 121.2, for a device with means for separating or guarding against solids in the working fluid.

- 144+, for a device comprising means for handling a bypass portion of working fluid which has not leaked through a joint.

- 168.1+, for a device comprising means for handling working fluid leakage through a joint.

- 170.1+, for a device having a bearing, seal, or liner between a runner portion and a static part.

169.2 Moisture or liquid separated from gaseous working fluid (e.g., condensate removal, etc.):

This subclass is indented under subclass 169.1. Device wherein moisture vapor or liquid carried in a gaseous state working fluid* is treated, disposed of, or otherwise dealt with separately from the gaseous working fluid.

- (1) Note. This subclass includes a device wherein a part of the working fluid which contains a higher proportion of moisture than the working fluid in general is removed from the working fluid.

169.3 Vane having specific moisture or liquid directing surface:

This subclass is indented under subclass 169.2. Device comprising a vane* working fluid* directing or other means which includes an outer boundary (surface) which has particular features for guiding the flow of moisture vapor or liquid formed or deposited thereon.

- (1) Note. The moisture vapor or liquid on the outer boundary of the vane or other directing means is usually guided to a channel or duct which carries the moisture or liquid away.

169.4 Axial flow blade set and area for collecting moisture or liquid thrown radially outward:

This subclass is indented under subclass 169.2. Device comprising a working member blade* row wherein the working fluid* flow path to, through, and from the blade row predominantly follows a path parallel to the runner's axis of rotation. The device further comprises a region radially outward of the blades which gathers moisture vapor or liquid projected outward by the blade row.

170.1 BEARING, SEAL, OR LINER BETWEEN RUNNER PORTION AND STATIC PART:

This subclass is indented under the class definition. Device comprising means located between a runner* and a fixed element which (a) reduces friction between the runner and the fixed element while providing a supporting or guiding function for the runner, (b) prevents or retards the flow of fluid between the runner and the fixed element, or (c) prevents or retards wear between the runner and the fixed element.

- (1) Note. A conventional runner rotating shaft* or shaft covering portion (i.e., sleeve) is not considered to be a part of a runner for the purposes of this and indented subclasses.
- (2) Note. Regarding (b) above, the fluid prevented or retarded from flowing is usually working fluid*.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 33+, for a device having a bearing which automatically adjusts in response to shaft speed or torque.
- 110+, for a device with lubricating, sealing, packing, or bearing means having a fluid path between the normal working fluid path and an interior part of an assembly which fluid path is positioned between two relatively moving apparatus parts.
- 115, for a device with a passage in a blade*, vane*, shaft*, or rotary distributor communicating with the working fluid*. Such a passage may direct fluid to a region between a runner* and a static part which fluid may act as a lubricant or seal.

- 116+, for a device with a diversely oriented inlet or an additional inlet for a diverse fluid, which fluid may be directed to a region between a runner and a static part to act as a lubricant or seal.
- 126+, for a device having a casing* which may have a seal, bearing, or liner attached to and moveable with the casing for adjustment.
- 168.1+, for a device having a seal, liner, or bearing between a runner* and a static part and means to dispose of any leakage therethrough. Note particularly subclass 168.3 for such a device with a screw-type pumping seal.
- 175+, for a device with means for causing or controlling fluid flow for reducing friction between two relatively moving parts other than a runner portion and a static part.
- 196+, for a device having a casing attached removable liner or wear member which lines or protects the casing at a location other than between a runner* or blade* and a static part.
- 229, for a device having a bearing, seal, or liner between a shaft or shaft sleeve and a static part.

SEE OR SEARCH CLASS:

- 74, Machine Element or Mechanism, subclasses 5+ for devices for gyroscopic action which have bearings which may be between a runner or blade and a casing. See the reference to Class 74 in section IV of the Class 415 definitions for a statement of class lines.
- 277, Seal for a Joint or Juncture, for a generic sealing means or process (e.g., seal between a runner* and another relatively movable part, seal between the two relatively moving members, does not recite enough details of the rotary kinetic device, etc.), subclasses 345+ for a seal between relatively movable parts (i.e., a dynamic seal).
- 384, Bearings, for a bearing or guide in which the runner is supported for motion, where there is insufficient disclosure of the rotary device to serve as a basis of classification in Class 415.

171.1 Dynamically created seal:

This subclass is indented under subclass 170.1. Device wherein the means prevents or retards the flow of fluid between the runner and the fixed element, wherein the means is formed by rotation of the runner, and wherein the means does not function when the runner is stationary.

- (1) Note. Such devices usually prevent or retard flow of working fluid* between the runner and the fixed element by establishing regions of differing fluid pressure which inhibit the flow by nature of the differing pressure.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 109, for a device with a shaft* connected fluid abutment member in a fluid filled shaft sealing chamber. The fluid in the chamber rotates with the shaft.
- 168.3, for a device with a screw-type pumping seal for handling working fluid leakage between a runner or shaft and a static part.

172.1 Means to seal radial flow pump runner inlet from outlet:

This subclass is indented under subclass 170.1. Device wherein the working fluid* path through the runner* is predominantly inwardly toward or outwardly from the runner's axis of rotation and wherein the runner adds energy to the working fluid (i.e., "pump"* runner). The means prevents or retards the flow of fluid between the runner's entrance and exit which flow does not pass through (i.e., is not acted upon by) the runner.

- (1) Note. A circumferential or peripheral flow runner is not considered to be a radial flow runner for the purposes of this subclass.

173.1 Between blade edge and static part:

This subclass is indented under subclass 170.1. Device wherein the means is located between a peripheral part of a working member blade* on the runner* and the fixed element.

- (1) Note. A device having a bearing, seal, or liner located between a blade supported

ring or shroud and a fixed element is not included in this subclass.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 55.4, for a turbine regenerative pump* having a seal at an end of a regenerative passage which seal may oppose a blade edge of the runner.
- 173.6, for a device having a bearing, seal, or liner between a blade* tip ring or shroud and a fixed element.

173.2 Selectively adjustable:

This subclass is indented under subclass 173.1. Device wherein the means (a) can be moved positively and at will and (b) can be retained in any one of a multiplicity of different positions.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 129+, for a device having a runner* or blade* selectively adjustable relative to a casing* which adjustment may adjust a bearing, seal, or liner between a blade* edge and a static part.

173.3 Resilient, flexible, or resiliently biased:

This subclass is indented under subclass 173.1. Device wherein the means (a) has a tendency to regain its original shape when bent, stretched, compressed, or otherwise deformed, (b) can be easily bent, twisted, or turned without breaking, or (c) comprises an element which urges, by spring-type force, the means toward a pre-determined position.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 140+, for a device having a resilient or moveably mounted blade* portion on an axially moveable runner* or shaft*.

173.4 Erodable or permanently deformable:

This subclass is indented under subclass 173.1. Device wherein the means is worn away or forever altered in shape just subsequent to or during operation of the device. Wear or alteration in shape is by design and usually occurs during device set up, break in, or under particular (i.e., extreme) operating conditions.

- (1) Note. A wear surface which merely wears slowly over time due to the action of a working member blade and which is replaced when worn beyond a certain degree is not included in this subclass unless the surface has particular characteristics promoting wear under certain conditions.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 9, for devices including a destructible, fusible, or deformable nonreusable part.

173.5 Labyrinth seal:

This subclass is indented under subclass 173.1. Device wherein the means prevents or retards the flow of fluid between the peripheral part of the working member blade* and the fixed element. The means comprises maze like or zig-zag interconnecting passages formed by the opposing working member peripheral part and fixed element surfaces, through which passages the fluid must flow to pass between the peripheral part of the blade and the fixed element.

173.6 Between blade supported radial tip ring and static part:

This subclass is indented under subclass 170.1. Device wherein the means is located between (a) an annulus or shroud centered about the runner's axis of rotation and supported by a runner blade* at a position predominantly at an outermost point of the blade as measured from the runner's axis of rotation and (b) the fixed element.

- (1) Note. The annulus or shroud usually comprises a blade ring which is supported by a multiplicity of runner blades, the ring being positioned at an outermost radial point of each blade as measured from the runner's axis of rotation.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 172.1, for a radial flow pump runner having a seal between a runner (e.g., ring supported shroud, etc.) and a static part which seals the runner's inlet from its outlet.

173.7 Between axial flow runner and vane or vane diaphragm structure:

This subclass is indented under subclass 170.1. Device wherein the working fluid* path to, through, and from the runner* is predominantly parallel to the runner's rotational axis (i.e., axial flow). The means is positioned between the (axial flow) runner and a partition member vane* or a structure which secures one or more such vanes in position relative to a casing*.

- (1) Note. A seal means which retards or prevents flow between a multiblade row axial flow runner and a vane or vane diaphragm structure which seal means is located between blade rows of the runner is included in this subclass.
- (2) Note. The structure which secures one or more vanes in position relative to a casing usually secures the vanes arcuately about and in a radial plane perpendicular to the rotational axis.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 173.1+, for a device having a seal between a runner* blade* edge and a static part, which static part may comprise a vane* or vane diaphragm portion.

174.1 Selectively adjustable:

This subclass is indented under subclass 170.1. Device wherein the means (a) can be moved positively and at will and (b) can be retained in any one of a multiplicity of different positions.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 33+, for a device having a bearing which automatically adjusts in response to shaft speed or torque.
- 113, for a device having a shaft* lubricating, sealing, packing, or bearing means comprising an assembly supported for movement to any of a plurality of selected positions and further comprising an internal working fluid* connection.
- 126+, for a device having a casing* which may have a seal, bearing, or liner

attached to and movable with the casing for adjustment.

- 129+, for a device having a runner selectively adjustable relative to a casing which adjustment may alter a bearing, seal, or liner between the runner and a static part.
- 132, for a device having an axially movable bearing supporting the end of a shaft* to adjust the shaft.
- 173.2, for a device having a selectively adjustable bearing, seal, or liner between a blade* edge and a static part.

174.2 Resilient, flexible, or resiliently biased:

This subclass is indented under subclass 170.1. Device wherein the means (a) has a tendency to regain its original shape when bent, stretched, compressed, or otherwise deformed, (b) can be easily bent, twisted or turned without breaking, or (c) comprises an element which urges, by spring-type force, the means toward a predetermined position.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 113, for a device having shaft sealing, packing, lubricating, or bearing means comprising an internal working fluid connection and a resilient portion.
- 173.3, for a device having a resilient, flexible, or resiliently biased bearing, seal, or liner between a runner* blade* edge and a static part.

174.3 Seal lies against axial face of runner hub:

This subclass is indented under subclass 174.2. Device wherein the means prevents or retards the flow of fluid between the runner* and the fixed element. The means contacts or abuts against a surface of the runner's central supporting structure (e.g., hub, etc.), which surface is generally perpendicular to the runner's axis of rotation.

- (1) Note. "Central supporting structure" of the runner does not include a runner shaft or a runner blade* supported ring or shroud for the purposes of this definition.

174.4 Erodable or permanently deformable:

This subclass is indented under subclass 170.1. Device wherein the means is worn away or forever altered in shape just subsequent to or during operation of the device. The wear or alteration in shape is by design and usually occurs during device set up, break in, or under particular (i.e., extreme) operating conditions.

- (1) Note. A wear surface which merely wears slowly over time due to the action of a runner and which surface is replaced when worn beyond a certain degree is not included in this subclass unless the surface has particular characteristics promoting wear under certain conditions.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 9, for devices including a destructible, fusible, or deformable part.
- 173.4, for a device having an erodable or deformable bearing, seal, or liner between a runner* blade* edge and a static part.

174.5 Labyrinth seal:

This subclass is indented under subclass 170.1. Device wherein the means prevents or retards the flow of fluid between the runner* and the fixed element. The means comprises maze like or zigzag interconnecting passages formed by the opposing runner part and fixed element surfaces, through which passages the fluid must flow to pass between the runner and the fixed element.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 173.5, for a labyrinth seal between a runner* blade* edge and a static part.

- 175** This subclass is indented under the class definition. Apparatus comprising a means specifically provided to positively move or prevent movement of a fluid which acts (1) to transfer heat between it and an apparatus part, (2) to reduce friction between two relatively moving parts or (3) as a sealing fluid to prevent, preclude or reduce unwanted flow of other fluid between two relatively moving apparatus parts.

- (1) Note. Included under this definition is an elevated tank containing lubricating, sealing or heat exchanging fluid for gravity flow of the fluid.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 109, for apparatus having a chamber containing sealing fluid and a member connected to and rotating with the shaft* continuously causes motion of the sealing fluid.
- 177+, for apparatus having heat exchanging means, but having no means, such as a fan, pump or valve specifically provided to positively move or control movement of the heat exchanging medium.

- 176** This subclass is indented under subclass 175. Apparatus in which the means is acted upon and moved by the working fluid*.

- (1) Note. The means may be merely an interface between the working fluid* and the heat exchanging, sealing or lubricating fluid which is moved or whose movement is prevented.

- 177** This subclass is indented under the class definition. Apparatus comprising means (1) to interchange heat between an apparatus part or the working fluid* and another part or fluid or (2) in contact with an apparatus part to reduce the transfer of heat from the part through the means.

- (1) Note. Included under (1) of this definition is a fin or rib which increases the area of heat transfer, or direct contact of a part with a fluid for heating or cooling, or passage of working fluid* at different temperatures on both sides of a wall.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 175, for a device in which there is means specifically provided (e.g., fan, pump, valve) to positively move or control movement of a heat exchange medium.

- 178** This subclass is indented under subclass 177. Apparatus comprising a solid barrier of form or arrangement to affect heat transfer there-through, there being working fluid* on at least one side of the barrier, there being fluid at another temperature on the other side.

- (1) Note. Included under this definition is ambient air as the other fluid provided there is a solid barrier of special form or arrangement (e.g., coil, fins) between it and the working fluid*. See also (1) Note in subclass 177.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 108, for device having a space between the casing* and a surrounding housing with the space being full of working fluid* to permit heat exchange between the working fluid* and parts of the apparatus.

SEE OR SEARCH CLASS:

- 60, Power Plants, subclasses 690+ for fluid motor in which the exhaust fluid is heated or cooled, see section IV of the Main Class Definition, reference to Class 60, (8).

- 179** This subclass is indented under subclass 178. Apparatus in which the heat exchange barrier is intermediate two sets of blades*, the barrier serving to transfer heat to or from the working fluid* as it passes from one set to the next succeeding.

- 180** This subclass is indented under subclass 177. Apparatus comprising an arrangement to transfer heat from the shaft*, seal or bearing by direct contact of a cooling fluid with such part.

- (1) Note. This definition accepts only those devices in which a fluid other than the working fluid* is used as the coolant; for devices using the working fluid* for this purpose, see the search notes below.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 116+, for a device in which the cooling fluid for contacting the shaft*, seal or bearing is then caused to enter upstream of

- all disclosed runner* stages and pass through at least one stage.
- 144+, for a device in which the cooling fluid is then caused to enter the working fluid* flow path at an intermediate runner* stage.
- 181** This subclass is indented under the class definition. Apparatus comprising an element, member or arrangement of element or apparatus parts to provide for working fluid* velocity of greater than the speed of sound through some apparatus part.
- (1) Note. The speed of sound or the velocity of propagation of compressional waves in the working fluid* varies as the temperature and pressure of use; a clear disclosure in the specification that supersonic velocity is obtained is sufficient to qualify under this definition.
- 182.1 WORKING FLUID PASSAGE OR DISTRIBUTING MEANS ASSOCIATED WITH RUNNER (E.G., CASING, ETC.):**
This subclass is indented under the class definition. Device comprising means (e.g., casing*, etc.) to deliver, conduct, guide, direct, or distribute the working fluid* to, around, or from a runner*.
- (1) Note. A device need not explicitly claim a runner to be in this and indented subclasses.
- (2) Note. Patents in this and indented subclasses have been cross referenced to Class 416, Fluid Reaction Surfaces (i.e., Impellers), appropriate subclasses, where particular runner structure has been disclosed. See section IV of the Class 415 definitions for a discussion of class lines.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 2.1+, for a device with means for controlling casing or flow guiding means in response to natural fluid current force or direction.
- 108, for a device having a casing and a spaced housing with the space vented to working fluid.
- 126+, for a device having a casing part selectively movable relative to a fixed support.
- 134+, for a device having a casing with a thermal expansion joint.
- 144+, for a device having means to guide or conduct at least a portion of the working fluid along a path which bypasses the runner.
- 146+, for a device including working fluid force responsive vane or flow control means.
- 148+, for a device having adjustable means to affect or control the flow of working fluid.
- SEE OR SEARCH CLASS:
- 138, Pipes and Tubular Conduits, subclasses 37+ for a fluid conduit having baffles or other means for changing the direction or rate of flow of fluid in the conduit.
- 239, Fluid Sprinkling, Spraying, and Diffusing, appropriate subclasses for means forming a free jet of fluid, the means not combined with runner structure.
- 416, Fluid Reaction Surfaces (i.e., Impellers), for particular runner structure.
- 183** This subclass is indented under subclass 182.1. Apparatus comprising a plurality of members (e.g., vanes*, pipes, or nozzles) each of which has means to convey or direct a portion of the working fluid* directly onto the runner*.
- (1) Note. The working fluid* streams may be directed to the same set of blades*, or to different sets of blades* on the same runner*.
- (2) Note. A set of blades* or bucket comprises at least two physically interrelated blades* or buckets which cooperate with each other to form a single composite structure against which the working fluid* may act. The blades* or buckets of a set may be arranged relative to each other to form any one of a variety of shapes (e.g., circle, spiral) but usually comprises a single circular annulus.

- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 52.1+, for means to redirect working fluid* back to the same blade* or set of blades* which the fluid had previously contacted.
- 93+, for means to conduct or guide a plurality of working fluid* streams in opposed directions to a runner*.
- 149.1+, for a device having selectively adjustable vane* or working fluid* control means upstream and downstream of a blade* set.
- 151+, for adjustable means to control the flow or working fluid* to a runner*.
- 208.1+, for plural vanes* or deflectors for working fluid* which are not. immediately upstream of the runner*
- 184** This subclass is indented under subclass 183. Apparatus in which the members comprise a plurality of spirally or volute shaped casings* or one spirally or volute shaped casing* has a plurality of guide or conveying means supported therewithin.
- 185** This subclass is indented under subclass 183. Apparatus in which the members are spaced equidistant from the runner* axis in a plane which is normal to the axis.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 159+, for a plurality of movable vanes* arcuately or circularly spaced around the runner* axis and positioned upstream of and controlling working fluid* quantity or direction onto a runner*.
- 208.2+, for a device having plural and arcuately or circularly arranged vanes* in a radial plane around the runner* axis, which vanes* are not immediately upstream of the runner*
- 186** This subclass is indented under subclass 185. Apparatus in which the members are positioned in the same plane as the runner* blade*.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 91, for distributing means radially interior of a set of runner* blades* enclosed on its outer radial periphery.
- 187** This subclass is indented under subclass 186. Apparatus comprising a plurality of sets of members spaced along the axis, a set comprising a plurality of members lying in a single plane perpendicular to the axis, each set distributing working fluid* onto a runner* or a blade* set.
- 188** This subclass is indented under subclass 186. Apparatus in which the members are within, or on a smaller radius than that of, the runner* blade*.
- 189** This subclass is indented under subclass 185. Apparatus in which the working fluid* guides or conducting means are retained or fastened in operative position by means which permits them to be readily disassembled from the adjacent casing* structure without destruction of any parts.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 209.2, for a device having plural and arcuately or circularly arranged vanes* in a radial plane around the runner* axis but not immediately upstream of the runner*, which device further includes means for mounting a diaphragm or plural vane* holder to a casing*.
- 209.3+, for a device having plural and arcuately or circularly arranged vanes* in a radial plane around the runner* axis but not immediately upstream of the runner*, which device further includes specific vane* mounting means.
- 190** This subclass is indented under subclass 189. Apparatus comprising retaining or fastening means for each of a plurality of working fluid* guides or conducting means spaced from each other in the direction of flow of the working fluid*.
- 191** This subclass is indented under subclass 185. Apparatus comprising a plurality of vanes*.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 8, for a device comprising a driven runner* immersed in a fluid and a vane*

in an unconfined fluid stream for guiding the working fluid*.

192 This subclass is indented under subclass 191. Apparatus in which the vanes* are asymmetrically curved about an imaginary line extending substantially radially from the runner* axis.

193 This subclass is indented under subclass 191. Apparatus comprising a plurality of sets of vanes* spaced along the axis, a set comprising a plurality of vanes* lying in a single plane perpendicular to the axis, each set distributing working fluid* onto a runner* or a blade* set.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

209.1, for a device having plural, axially spaced vane* sets (a) acting successively or (b) having particular means for axially spacing the vane* sets; the vane* sets each comprise plural and arcuately or circularly arranged vanes* in a radial plane around the runner* axis.

194 This subclass is indented under subclass 193. Apparatus in which the vanes* of one of the groups are larger in length or width or are positioned further from each other than the vanes* in another set.

195 This subclass is indented under subclass 191. Apparatus in which the spacing between any two adjacent vanes* of one set is different than the spacing between any other two adjacent vanes* in the same set.

196 This subclass is indented under subclass 182.1. Apparatus comprising a member secured to the interior of a working fluid* conduit or casing* which member may be replaced and which acts to protect the conduit wall or casing* against the erosive or corrosive effect of the working fluid*.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

128, for an adjustment liner for the inner periphery of a casing*.

170.1+, for a similar lining or wear member attached to or for the transverse face or peripheral edge of a runner* disc or blade*.

197 This subclass is indented under subclass 196. Apparatus in which the member is made of a nonmetallic material.

198.1 This subclass is indented under subclass 182.1. Apparatus comprising a plurality of blade* sets fixedly or unitarily associated with each other for contacting the working fluid*.

(1) Note. The blade* sets may be (a) on a plurality of runners*, i.e., a set on each of at least two runners*, or (b) on opposite sides of a shroud plate to act on the fluid in series or in parallel.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

55.5+, for a regenerative turbine pump* having plural, rigidly related blade* sets.

57.2, for a device having plural, independent, serially acting means for the reentry of working fluid* to a first blade* set and further having an additional blade* set in the reentry path which may be rigidly related to the first blade* set.

58.1, for a device having means for the reentry of working fluid* to a first blade* set and further having an additional blade* set in the reentry path which may be rigidly related to the first blade* set.

59.1, for a device having plural blade* sets and including means for the reentry of working fluid* to one of the blade* sets.

62+, for plural blade* sets in an arrangement of plural runners* supported for relative movement.

64, for a runner* having plural blade* sets on a common radial plane.

83, for a device having a runner* with annular blade* rows or fluid channels spaced on a common radial plane.

93+, appropriate subclasses indented thereunder, especially subclasses 93 and 101+, for an arrangement in which end thrust is balanced by working fluid* flowing in at least two axial directions and comprising plural rigidly related blade* sets.

106, for a device comprising a blade* on each side of a common support wall

- or shroud plate in a runner* and a port transferring fluid from one side of the wall or plate to the other.
- 143, for plural runners* with diverse or different flow paths through the runners*.
- 179, for a device comprising plural serial stages of runner* blades* and a heat exchange apparatus intermediate two stages.
- 199.1** This subclass is indented under subclass 198.1. Apparatus which includes at least two blade* sets for contacting the working fluid* sequentially, and wherein the working fluid* moves predominately inwardly towards or outwardly from the runner* axis as the working fluid* moves through each blade* set, and which further includes immobile structure between the blade* sets for altering the direction of movement of the working fluid* as it passes from a preceding to a succeeding blade* set.
- 199.2** This subclass is indented under subclass 199.1. Apparatus wherein the flow directing structure includes stationary vanes* which form channels that extend between the blade* sets and cause the working fluid* to be separated into plural, generally parallel, flow paths as the working fluid* moves between the blade* sets.
- 199.3** This subclass is indented under subclass 199.2. Apparatus wherein a cross section of the channel forming vanes* taken in a plane perpendicular to the runner* axis forms a shape that, at least in part, includes a curved line that extends around the runner* axis at a radius that continually increases or decreases relative to the runner* axis.
- 199.4** This subclass is indented under subclass 198.1. Apparatus wherein the working fluid* moves through at least one of the blade* sets in a direction predominately parallel to the axis of the runner.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 74, for a device comprising plural rigidly related blade* sets, one of which is a spirally arranged blade* or fluid conducting passage of at least 360° flight.
- 77+, for an axial flow runner* comprising blades* extending radially inwardly and outwardly from a common annulus.
- 199.5** This subclass is indented under subclass 199.4. Apparatus which includes at least another blade* set for contacting the working fluid* sequentially and wherein said fluid moves in a direction predominately parallel to the runner* axis as the fluid moves through each blade* set and which apparatus further includes immobile structure between the blade* sets for altering the directional movement of the fluid as it passes from a preceding blade* set to a succeeding blade* set.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 149.4, for a device having plural selectively adjustable vane* or working fluid* control means alternating along a working fluid flow path with axial flow blade rows
- 199.6** This subclass is indented under subclass 199.4. Apparatus which further includes another blade* set arranged for contacting the working fluid* sequentially, and wherein the working fluid* path through said other blade* set is in a direction predominately inwardly towards or outwardly from the runner* axis.
- 200** This subclass is indented under subclass 182.1. Apparatus in which the material of the casings*, vane* of flow guiding means is specifically recited in a claim.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 216.1, for a specific recitation of the material constituting a shaft*.
- 217.1, for a specific recitation of a corrosion resistant or nonmetallic material constituting a runner*.
- 201** This subclass is indented under subclass 182.1. Apparatus in which a part of the casing* may be removed or moved to a different position to permit admittance to the interior thereof while the apparatus is otherwise in assembled condition.
- 202** This subclass is indented under subclass 182.1. Apparatus comprising a motor* runner* and a tubular member with a flow modifying orifice

at the end thereof through which the working fluid* passes onto the runner*.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 80, for a device with a motor runner motivated by a reaction-type jet discharge nozzle from an internal working fluid conduit.
- 167, for a nozzle adjustably or shiftably mounted to vary the direction of discharge of working fluid* onto the runner*.
- 183+, for a device having plural working fluid* distributing means immediately upstream of a runner*.
- 185+, appropriate subclasses preceding 191 for plural nozzles arranged circularly around the runner* axis.

SEE OR SEARCH CLASS:

- 239, Fluid Sprinkling, Spraying, and Diffusing, appropriate subclasses for nozzles, per se.

203 This subclass is indented under subclass 182.1. Apparatus comprising a housing in which the runner* is positioned, said housing having an inlet or outlet for the working fluid*, the longitudinal axis of the inlet or outlet being substantially perpendicular to a radius drawn to the housing wall.

204 This subclass is indented under subclass 203. Apparatus comprising a housing of spiral or volute form.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 212.1, for a scroll or helical type casing with a specific exit nozzle.

205 This subclass is indented under subclass 204. Apparatus in which the spiral or volute housing conducts the working fluid* to the runner* and decreases in volume while approaching the runner*.

206 This subclass is indented under subclass 203. Apparatus in which the outlet is substantially perpendicular to a radius drawn to the housing wall and the inlet is directed parallel to the runner* axis.

207 This subclass is indented under subclass 182.1. Apparatus comprising a pump* runner* and, downstream of the blade*, a flow path increasing in area in the direction of working fluid* flow.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 203+, for a working fluid* path downstream of a runner*, expanding in area in the direction of fluid flow*, in a device in which the casing has a tangential inlet or outlet for the working fluid*.

208.1 Vane or deflector:

This subclass is indented under subclass 182.1. Device wherein the means to deliver, conduct, guide, direct, or distribute the working fluid* to, around, or from the runner* comprises a static (nonrotating) partition member vane* or other working fluid directing means in the working fluid flow path.

- (1) Note. A device comprising mere working fluid conducting passage walls is not included in this subclass.
- (2) Note. A device comprising plural vanes or other working fluid directing means immediately upstream of a runner is not included in this subclass. See subclasses 183+.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 2.1+, for a device with means for controlling casing* or flow guiding means in response to natural fluid current force or direction which means may include a vane or deflector.
- 8, for a device having a driven, fluid immersed runner with a vane in an unconfined fluid stream.
- 12, for a device with a bimetallic vane or vane adjustment means.
- 53.2, for a device having a cross flow runner blade* set and a vane or flow guide inside the blade set.
- 55.2+, for a turbine regenerative pump* having means to deflect working fluid in a regenerative passage.
- 142, for a device comprising a shaft* bearing combined with or retained by a

- vane in a surrounding working fluid space.
- 146+, for a device comprising working fluid force responsive vane control.
 - 148+, for a device comprising selectively adjustable vane or other working fluid control means.
 - 173.7, for a device comprising bearing, sealing, or liner structure between a vane or vane diaphragm structure and an axial flow runner.
 - 183+, for a device comprising plural vanes or deflectors immediately upstream of a runner.
 - 199.1+, for a device comprising serial, rigidly related, radial flow blade* sets and an intermediate stationary flow diverter.
 - 199.5, for a device comprising serial, rigidly related, axial flow blade* sets and an intermediate stationary flow diverter.
 - 218.1, for a device with a working fluid directing conical runner hub (integral with runner) having its small diameter facing upstream.

208.2 Plural and arcuately or circularly arranged in radial plane around runner axis:

This subclass is indented under subclass 208.1. Device comprising at least two such vanes* or other directing means which are equidistantly spaced from the runner's* axis of rotation and are positioned in a (radial) plane perpendicular to the axis.

- (1) Note. The guiding vanes or other directing means may intersect the runner's axis of rotation.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 56.3, for a device with pump* priming working fluid reentry means which includes plural and arcuately arranged vanes around the runner.
- 159+, for a device comprising a plurality of vanes upstream of and arcuately or circularly arranged around the runner axis, at least one of which vanes is selectively adjustable to control the working fluid amount or direction.
- 185+, for a device comprising plural vanes arcuately or circularly arranged around a runner axis and located immediately upstream of the runner.

208.3 Plane intersects with runner blade:

This subclass is indented under subclass 208.2. Device wherein the (radial) plane passing through the vanes* or other directing means also passes through at least a portion of a working member blade* of the runner*.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 164, for a device comprising plural vanes which are upstream of a runner, individually pivoted parallel to the runner axis, and arcuately or circularly arranged around the runner axis in a radial plane which passes through a blade of the runner, at least one of which vanes is selectively adjustable.
- 165+, for a device comprising plural vanes which are upstream of a runner and arcuately or circularly arranged around the runner axis in a radial plane which passes through a blade of the runner, at least one of which vanes is selectively adjustable.
- 186+, for a device comprising plural vanes which are immediately upstream of a runner and arcuately or circularly arranged around the runner axis in a radial plane which passes through a blade of the runner.

208.4 Plural, radially spaced vane sets:

This subclass is indented under subclass 208.3. Device comprising at least two groups of such vanes* or other directing means wherein each group (a) comprises at least two of the vanes or other directing means equidistantly spaced from the runner's* axis of rotation, (b) is positioned in the (radial) plane, and (c) is positioned at a different radius from the runner's axis of rotation.

208.5 Nonradial flow runner:

This subclass is indented under subclass 208.3. Device wherein the working fluid* flow path through the runner* is in a direction other than predominantly inwardly toward or outwardly from the runner's axis of rotation.

- (1) Note. Circumferential and axial flow runners are considered to be examples of nonradial flow runners for the purposes of this subclass.

209.1 Plural, axially spaced vane sets acting successively or having specific spacing means:

This subclass is indented under subclass 208.2. Device comprising first and second rows of such vanes* or other directing means positioned apart along the runner's* axis of rotation. Each row comprises at least two of the vanes or other directing means positioned equidistant from the runner's axis of rotation and in a (radial) plane perpendicular to the axis of rotation. The device further (a) directs the working fluid* through the two rows in sequence or (b) comprises particular means to position the two rows relative to one another along the axis of rotation.

- (1) Note. The device may include a runner blade* row positioned between the axially spaced rows of vanes or other directing means.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 187, for a device comprising first plural distributing means immediately upstream of a runner, which first means are arcuately or circularly arranged around the runner axis in a radial plane with a blade of the runner, the device further comprising second plural distributing means axially spaced from the first plural distributing means.
- 193+, for a device comprising plural, axially spaced vane sets arcuately or circularly arranged around the runner's axis of rotation wherein one of the sets is immediately upstream of the runner.
- 199.5, for a device having plural, serial, axial flow blade sets with an intermediate stationary flow diverter.

209.2 Having means for mounting diaphragm or plural vane holder to casing:

This subclass is indented under subclass 208.2. Device comprising a structure to which the vanes* or other directing means are attached and further comprising means for securing the structure in position relative to a casing*.

- (1) Note. The structure must be distinct from the vanes or other directing means for inclusion in this subclass. Means for

securing an integral single or double vane (e.g., nozzle block) to a casing is not included in this subclass.

- (2) Note. The device need not explicitly claim the presence of the vanes or other directing means provided the presence of such vanes or other means is clearly understood.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 189+, for a device comprising plural vanes which are immediately upstream of a runner*, arcuately or circularly arranged around the runner axis, and removably secured or mounted in a casing.
- 209.3+, for a device comprising particular means for mounting vanes to a supporting structure.

209.3 Having specific vane mounting means:

This subclass is indented under subclass 208.2. Device wherein particular significance is attributed to means for securing one of the vanes* or other directing means in position relative to a supporting structure.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 189+, for a device comprising plural vanes which are immediately upstream of a runner*, arcuately or circularly arranged around the runner axis, and removably secured or mounted in a casing.
- 209.2, for a device comprising means for mounting a diaphragm or plural vane holder to a casing.

209.4 Vane fixed between radially separate surfaces:

This subclass is indented under subclass 209.3. Device wherein the vane* or other directing means is held intermediate two structures at opposite ends of the vane or other directing means, and wherein the two structures lie at different distances from the runner's* axis of rotation.

- (1) Note. Either or both of the two structures may consist of circumferentially extending segments connected together.

210.1 Fixed between radially separate surfaces:

This subclass is indented under subclass 208.2. Device wherein the vane* or other directing means is held intermediate two structures at opposite ends of the vane or other directing means; the two structures lie at different distances from the runner's* axis of rotation.

- (1) Note. Either or both of the two structures may consist of circumferentially extending segments connected together.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

209.4, for a device comprising plural and arcuately or circularly arranged vanes which lie in a radial plane around a runner axis, are fixed between radially separate surfaces, and which include specific vane mounting means.

211.1 In radial plane with runner blade:

This subclass is indented under subclass 208.1. Device wherein the vane* or other directing means lies in a plane normal to the runner's* axis of rotation, which plane passes through at least a portion of a working member blade*.

- (1) Note. A device having a mere partition or wall with an orifice in which a runner* is positioned is not included in this subclass.
- (2) Note. In axial flow devices, a "vane or other directing means" positioned about the periphery of a runner blade row is generally distinguished from a "casing" structure about the blade row in that a vane or other directing means (a) encloses the periphery of the blade row over less than half of the axial extent of the blade row and (b) does not act to support the runner.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

53.2, for a device having a cross flow runner blade set and a vane or flow guide inside the blade set.

55.2+, for a turbine regenerative pump* having means to deflect working fluid* in a regenerative passage, which means

lies in a radial plane with the runner blade.

148+, for a device comprising a selectively adjustable vane which may lie in a radial plane with a runner blade.

208.3+, and see the search notes therewith, for a device comprising plural vanes arcuately or circularly arranged in a radial plane around the runner axis, which plane passes through at least a portion of a working member Blade.

220+, for a device having a casing with an axial flow runner which casing may include a portion which encloses the periphery of the blade set and lies in a plane passing through the blade set.

211.2 Downstream of runner:

This subclass is indented under subclass 208.1. Device wherein the vane* or other directing means is located beyond the runner* in the direction of the working fluid* flow.

212.1 Scroll or helical type casing with specific exit nozzle:

This subclass is indented under subclass 182.1. Device comprising a casing* of spiral or volute form and a discharge opening therefrom, wherein particular significance is attributed to the discharge opening.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

204+, for a device having a scroll type casing and a tangential inlet or outlet.

208.1+, for a device having a vane* or deflector downstream of a runner*.

213.1 Casing with mounting means:

This subclass is indented under subclass 182.1. Device wherein the means comprises a casing* and a means for securing or anchoring the casing to an external frame of reference.

- (1) Note. External frames of reference may include such items as the floor or another structure on which the device is anchored, for example.

- (2) Note. Devices comprising means to secure a casing to an outer housing (e.g., securing an inner casing to an outer casing) are included in this subclass if the space between the inner casing and the

outer housing is not vented to the working fluid*.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 108, for a device comprising a casing and an outer housing wherein working fluid is vented to the space between the casing and housing.
- 126, for a device comprising a casing part selectively movable relative to a fixed support.

SEE OR SEARCH CLASS:

- 248, Supports, appropriate subclasses, for support structure, per se, particularly subclasses 637+ for the combination of a support and a casing claimed so broadly as to be of general utility. See the Class 415 definition line notes for a discussion of class lines.

214.1 Casing having multiple parts releasably clamped (e.g., casing seal, etc.):

This subclass is indented under subclass 182.1. Device wherein the means comprises a casing* which includes a plurality of sections which are positioned with relation to one another by pressing or wedging means.

- (1) Note. Devices comprising multiple casing parts screwed, bolted, or riveted together are included in this subclass.
- (2) Note. A seal positioned between two or more releasably clamped casing parts is included in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 126, for a device comprising a casing part selectively movable relative to a fixed support.
- 201, for a device comprising a casing having an access opening through a portion of the casing or cover.

215.1 Casing having multiple parts welded, cemented, or fused:

This subclass is indented under subclass 182.1. Device wherein the means comprises a casing* which includes a plurality of sections which are positioned with relation to one another by (a)

liquefying or melting together by heat or (b) by adhesive bonding.

SEE OR SEARCH CLASS:

- 219, Electric Heating, subclasses 136+ for metal heating arc welding devices or processes.

216.1 With runner shaft of specific shape or material:

This subclass is indented under subclass 182.1. Device comprising a shaft* for the runner* wherein particular significance is attributed to the surface configuration or physical substance of the shaft.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 124.2, for a device including a shaft transmission train having flexible means which may include a flexible shaft or shaft coupling.

SEE OR SEARCH CLASS:

- 416, Fluid Reaction Surfaces (i.e., Impellers), subclasses 244+ for runner support mounting carrier, or fairing structure which may include a runner shaft of a specific shape or material.
- 464, Rotary Shafts, Gudgeons, Housings, and Flexible Couplings for Rotary Shafts, subclasses 179+ for rotary shaft structure.

217.1 With runner having corrosion resistant or nonmetallic portion:

This subclass is indented under subclass 182.1. Device wherein the runner* comprises (a) metal which tends to resist or inhibit wearing away by chemical action or (b) a nonmetallic substance.

- (1) Note. Examples of materials found under this definition include stainless steel, ceramics, porcelain, and glass.
- (2) Note. Although it includes subject matter better suited to Class 416, Fluid Reaction Surface (i.e., Impellers), this subclass has been retained since the subject matter is not currently provided for in Class 416.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 141, for a device having a flexible runner blade* which may be corrosion resistant or nonmetallic.
- 170.1+, for a device having a runner with a lining or wear member attached to a runner portion.
- 197, for a device having a passage or casing* attached removable liner or wear member of nonmetallic material.
- 200, for a device with a casing* wherein particular significance is attributed to the casing or vane* material.
- 216.1, for a device comprising working fluid* passage or distributing means with a runner shaft* of a specific material which may be corrosion resistant or nonmetallic.

SEE OR SEARCH CLASS:

- 416, Fluid Reaction Surfaces (i.e., Impellers), subclasses 241+ for an impeller comprising a blade structure of a specific composition which may include corrosion resistant or nonmetallic materials.

218.1 With runner having conical hub including small diameter facing upstream:

This subclass is indented under subclass 182.1. Device wherein the runner* comprises a rotating base member which support a blade*. The rotating base member has sides which increase evenly in diameter with the lesser diameter portion facing against the direction of working fluid* flow so as to act somewhat as a guide to direct the flow toward the blade.

SEE OR SEARCH CLASS:

- 416, Fluid Reaction Surfaces (i.e., Impellers), subclasses 245+ for a runner comprising a coaxially mounted spinner or fairwater cap, subclass 188 for a rotor comprising a flow confining or deflecting web or end plate which is circumferentially and radially continuous and which is conical.

219.1 Casing with axial, conical flow runner:

This subclass is indented under subclass 182.1. Device wherein the means comprises a casing* and wherein the working fluid* flows to,

through, and from the runner* along a path extending along the runner's axis of rotation. The working fluid path has a ring like or annular cross section taken perpendicular to the axis of rotation, which cross section is centered about and which cross section decreases or increases in diameter along the axis of rotation.

- (1) Note. Working fluid flow to, through, and from a runner which flow is radial only to an extent necessary for the expansion or compression of working fluid passing axially through the runner is not considered to be axial, conical flow.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 218.1, for a casing with a runner including a working fluid directing conical hub having its small diameter facing upstream.
- 220+, for a casing with an axial flow runner.

220 Casing with axial flow runner:

This subclass is indented under subclass 182.1. Device wherein the means comprises a casing* and wherein the working fluid* path to, through, and from the runner* is predominantly parallel to the runner's axis of rotation.

- (1) Note. In axial flow devices, a "casing" positioned about the periphery of a runner blade* row is generally distinguished from a vane* or deflector in that a casing (a) encloses the periphery of the blade row over more than half of the axial extent of the blade row or (b) includes means to support the runner.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 4.3, for a device comprising an axial flow runner with means for controlling a casing or flow guiding means in response to natural fluid current force.
- 4.5, for a device comprising an axial flow runner with means for controlling a casing or flow guiding means in response to natural fluid current direction.
- 72+, for a device comprising a casing with a runner having a spirally arranged blade or fluid passage which extends

- along the runner axis and may direct the fluid along an axial flow path.
- 77+, for a device comprising a casing with an axial flow runner having blades extending radially inward and outward from a common annulus.
- 91, for a device comprising a casing with an annular runner having an inwardly projecting blade which may direct the fluid along an axial flow path.
- 170.1+, for a device comprising a bearing, seal or liner between an axial flow runner or runner blade and a static part.
- 199.4+, for a device comprising a casing with a runner having plural rigidly related blade sets at least one set of which directs the fluid along an axial flow path.
- 208.1+, for a device having a vane* or deflector for a runner which may include an axial flow blade set, particularly subclass 211.1 in which the vane or deflector is in the same radial plane as the blade set.
- 908, for a natural fluid current motor* having an axial flow runner.

SEE OR SEARCH CLASS:

- 416, Fluid Reaction Surfaces (i.e., Impellers), appropriate subclasses, for impeller structure, per se.

- 221 Having specific features for liquid flow:**
This subclass is indented under subclass 220. Device comprising structure particularly adapted to working fluid* which is in the liquid (i.e., incompressible) state.
- 222 Pump with casing narrowing to runner:**
This subclass is indented under subclass 220. Device wherein the runner* rotates so as to increase the energy of the working fluid* (i.e., pump*); the casing* member directs the working fluid along a path decreasing in cross sectional area as it approaches the runner.
- (1) Note. A device comprising a casing member wherein the path decreases in cross sectional area in the region of a runner blade* row (i.e., in the plane of the blade row) is included in this subclass.

- (2) Note. A device comprising an axial flow multistage runner casing which decreases slightly in cross section while guiding working fluid past several blade rows is not included in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 208.1+, for a device having a vane* or deflector which may form a passage which narrows to a pump runner; particularly subclass 211.1 wherein the vane or deflector is in a radial plane with a runner blade.

223 Having runner in orifice of radially extending partition or casing element:

This subclass is indented under subclass 220. Device wherein the runner* is positioned in an opening (a) of a wall generally perpendicular to the runner's axis of rotation or (b) of a casing* member element which extends perpendicularly to the runner's axis of rotation.

- (1) Note. A device comprising a mere tube or pipe with a runner positioned inside is not included in this subclass.

224 Casing with nonradial flow runner (e.g., circumferential flow etc.):

This subclass is indented under subclass 182.1. Device wherein the means comprises a casing* and wherein the working fluid* flow path through the runner* is in a direction other than predominantly inwardly toward or outwardly from the runner's axis of rotation.

- (1) Note. The flow path is often in a direction around the periphery of the runner (i.e., circumferential flow).

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 88, for a pump device comprising a casing with a runner having a rotating inlet end or scoop immersed in liquid.
- 92, for a device comprising a casing with a motor runner having a working fluid trapping pocket.
- 202, for a device comprising a casing with a motor runner and further comprising a nozzle discharging onto the runner.

- 203+, for a device having a tangential inlet or outlet and a nonradial flow runner.
- 208.5, for a device comprising a nonradial flow runner having plural vanes or deflectors arcuately or circularly arranged around the runner's axis of rotation.
- 219.1, for a device comprising a casing with an axial, conical flow runner.
- 220+, for a device comprising a casing and an axial flow runner.

SEE OR SEARCH CLASS:

- 73, Measuring and Testing, subclasses
 - 217+ for a device for measuring volume or rate of flow which is of the tank type with a rotary bucket, and subclasses 861.79+ for a device for measuring volume or rate of flow which uses a turbine which may be of a nonradial flow type.
- 416, Fluid Reaction Surfaces (i.e., Impellers), subclasses 223+ for specific blade structure of a runner which may be of the nonradial type.

224.5 Radial flow casing having vaneless annulus diffuser:

This subclass is indented under subclass 182.1. Device comprising a casing* which guides working fluid* along a decelerating flow path having no vanes. The path (a) extends in a plane perpendicular to the runner's* axis of rotation and (b) is predominantly inwardly toward or outwardly from the runner's axis of rotation.

225 Exit chamber in radial plane axially offset from runner (e.g., sludge pump, etc.):

This subclass is indented under subclass 182.1. Device wherein the means comprises a working fluid* flow cavity or chamber which the working fluid enters after having been acted upon by the runner*. The cavity (a) generally extends radially in a plane perpendicular to the runner's axis of rotation, and (b) is spaced from the runner in a direction parallel to the runner's axis of rotation.

- (1) Note. A device merely having a working fluid flow passage which conducts the working fluid axially away from a runner is not included in this subclass.

- (2) Note. This subclass includes many devices for pumping sewage or sludge.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 203+, for a device comprising a casing* having a tangential inlet or outlet, which device may have a ring shaped flow cavity spaced from the runner in a direction parallel to the runner's axis of rotation.
- 220+, for a device comprising a casing* with an axial flow runner, which device may have a flow pipe or path of annular cross section which conducts the working fluid away from the runner.
- 913, for a device comprising an inlet and outlet with concentric portions.

226 Annular exit chamber outward of runner:

This subclass is indented under subclass 182.1. Device wherein the means comprises a working fluid* flow cavity which the working fluid enters after having been acted upon by the runner*. The cavity is (a) generally in the shape of a ring (annulus) extending around the runner and (b) located adjacent and at a radius greater than the outer periphery of the runner.

- (1) Note. The cavity is most commonly located in the same plane as the runner.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 203+, for a device comprising a casing* having a tangential inlet or outlet, which casing may also have a ring shaped flow cavity around the runner's outer periphery.
- 208.1+, for a vaned* device which may comprise a working fluid flow cavity located around the outer periphery of the runner.

227 Runner having flow confining continuous passage:

This subclass is indented under subclass 182.1. Device wherein the runner* comprises an uninterrupted working fluid* pathway which extends from the runner inlet to the runner outlet and wholly confines the fluid while in work-

ing engagement therewith over at least a portion of the pathway.

- (1) Note. Patents in this subclass have been cross referenced to Class 416 where particular runner structure has been disclosed.

SEE OR SEARCH CLASS:

416, Fluid Reaction Surfaces (i.e., Impellers), subclasses 179+ for a rotor comprising a flow confining or deflecting web, shroud, or continuous passage, particularly subclasses 186+ for a runner comprising a circumferentially and radially continuous web or end plate, an opposed annular surface, and in-between adjacent blades.

228 Runner having full circular shroud for blades:

This subclass is indented under subclass 182.1. Device wherein the runner* comprises at least two working member blades* extending from a working fluid* flow directing surface, which surface (a) extends generally perpendicular to and radially away from the runner's axis of rotation, (b) is continuous from the center to the radial periphery, and (c) has a radial periphery which lies, at all points, at a greater radial distance from the runner's axis of rotation than the radially outermost point of any of the blades.

- (1) Note. The blades usually extend from the flow directing surface in a direction parallel to the runner's axis.
- (2) Note. The runner under this definition may be referred to as a semi-open impeller.
- (3) Note. Patents in this subclass have been cross referenced to Class 416 where particular runner structure has been disclosed.

SEE OR SEARCH THIS CLASS, SUBCLASS:

227, for a device including a runner comprising a flow confining continuous passage which may include a full circular shroud for blades.

SEE OR SEARCH CLASS:

416, Fluid Reaction Surfaces (i.e., Impellers), subclasses 179+ for a rotor comprising a flow confining or deflecting web or shroud.

229 BEARING, SEAL, OR LINER BETWEEN SHAFT OR SHAFT SLEEVE AND STATIC PART:

This subclass is indented under the class definition. Device comprising means located between a shaft* or shaft covering portion and a fixed element which (a) reduces friction between the shaft or shaft covering portion and the fixed element while providing a supporting or guiding function for the shaft or shaft covering portion (b) prevents or retards the flow of fluid between the shaft or shaft covering portion and the fixed element, or (c) prevents or retards wear of the shaft or shaft covering portion.

- (1) Note. A runner* hub structure is not considered to be a shaft covering portion for the purposes of this and indented subclasses.

SEE OR SEARCH THIS CLASS, SUBCLASS:

33+, for a device having a runner, blade*, shaft, or bearing which automatically adjusts in response to shaft speed or torque.

109, for a device with a shaft connected fluid abutment member in a sealing fluid filled chamber (sealing the shaft).

110+, for a device with lubricating, sealing, packing, or bearing means having an internal working fluid* connection.

115, for a device with a passage in a blade*, vane*, shaft, or rotary distributor communicating with the working fluid*. Such a passage may direct working fluid to a region between a shaft and a static part.

116+, for a device with a diversely oriented inlet or an additional inlet for a diverse fluid, which fluid may be directed to a region between a shaft and a static part.

126+, for a device having a casing* which may have a shaft seal, bearing, or liner

- attached to and movable with the casing* for adjustment.
- 132, for a device having a bearing supporting the end of a shaft which bearing is axially movable to adjust the shaft.
- 142, for a device having a shaft bearing combined with or retained by an arm or vane* in the surrounding working fluid* space.
- 168.1+, for a device having a seal, liner, or bearing between a shaft and a static part and means to dispose of any working fluid* leakage.
- 170.1+, for a device having a bearing, seal, or liner between a nonshaft runner portion and a static part, which bearing, seal, or liner may also interact with the shaft.

SEE OR SEARCH CLASS:

- 74, Machine Element or Mechanism, subclasses 5+ for devices for gyroscopic action which have bearings which may be between a shaft and a casing. See the reference to Class 74 in section IV of the Class 415 definition for a statement of class lines.
- 384, Bearings, for a shaft bearing or guide, per se.

230 Seal:

This subclass is indented under subclass 229. Device wherein the means prevents or retards the flow of fluid between the shaft* or shaft covering and the fixed element.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 168.2+, for a device having means for handling working fluid* leakage through a seal between a runner* or shaft and a static part.

SEE OR SEARCH CLASS:

- 277, Seal for a Joint or Juncture, for a generic sealing means or process (e.g., seal between a runner* and another relatively movable part, seal between the two relatively moving members, does not recite enough details of the rotary kinetic device, etc.), subclasses 345+ for a seal between relatively movable parts (i.e., a dynamic seal).

231 Resiliently biased:

This subclass is indented under subclass 230. Device comprising an element which urges, by spring-type force, the (seal) means toward a predetermined position.

232 MISCELLANEOUS:

This subclass is indented under the class definition. Device not provided for in the above subclasses.

- (1) Note. Patents directed to particular runner* structure but properly assignable to Class 415 have been placed in the Class 415 schedule, where most appropriate (note, in particular, subclasses 182.1+), and have been cross referenced to Class 416. See section IV of the Class 415 definitions for a discussion of class lines.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 182.1+, for a device comprising working fluid passage or distributing means for a runner* (e.g., casing*, etc.). Note, in particular, subclasses 216.1 with specific shaft* shape or material, 217.1 with runner having corrosion resistant or nonmetallic portion, and 218.1 with runner having conical hub including small diameter facing upstream.

SEE OR SEARCH CLASS:

- 416, Fluid Reaction Surfaces (i.e., Impellers), for particular runner structure.

CROSS-REFERENCE ART COLLECTIONS

The following subclasses are collections of published disclosures pertaining to various specified aspects of the rotary kinetic fluid motor* and pump* art which aspects do not form appropriate bases for subclasses in the foregoing classification (i.e., subclasses superior hereto in the schedule). Only cross-reference patent copies reside in the cross-reference art collection subclasses; these subclasses do not contain "original" patent copies. These subclasses may be of further assistance to the searcher, either as a starting point in searching this class or as an indication of further related fields of search inside or outside the class. Thus, there is here provided a second access for retrieval of a limited number of types of disclosures.

- (1) Note. Disclosures are placed in these subclasses for their value as references and as leads to appropriate main or secondary fields of search, without regard to their original classification or their claimed subject matter.
- (2) Note. The disclosures found in the following subclasses are examples, only, of the indicated subject matter, and in no instance do they represent the entire extent of the prior art.
- 900 ROTARY BLOOD PUMP:**
Rotary device which adds energy to working fluid* (i.e., “pump”* device) comprising blood.
- 901 DRILLED WELL-TYPE PUMP:**
Rotary device which adds energy to working fluid* (i.e., “pump”* device). The device operates to draw working fluid through a well shaft usually bored into the earth.
- (1) Note. The working fluid usually comprises oil, gas, water, or brine.
- 902 ROTARY PUMP TURBINE PUBLICATIONS:**
Published material, other than patents, relating to a rotary device which adds energy to working fluid* (i.e., “pump”* device) or which obtains mechanical power from kinetic or potential energy in a working fluid (i.e., “motor”* device). Such material includes magazine articles, company brochures, text excerpts, etc.
- 903 WELL BIT DRIVE TURBINE:**
Rotary device which obtains mechanical power from kinetic or potential energy in a working fluid* (i.e., “motor”* device) to drive a boring cutter for drilling a well shaft, usually in the earth.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
904, for a motor device for driving a tool other than one for drilling a well (e.g., dental drill, etc.).
- 904 TOOL DRIVE TURBINE (E.G., DENTAL DRILL, ETC.):**
Rotary device which obtains mechanical power from kinetic or potential energy in a working fluid* (i.e., “motor”* device) to drive an implement or tool other than one for drilling a well shaft.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
903, for a motor device for driving a boring cutter for drilling a well shaft.
- 905 NATURAL FLUID CURRENT MOTOR:**
Rotary device which obtains mechanical power from kinetic or potential energy in a flowing, unconfined, and natural working fluid* such as a wind or water stream (i.e., “motor”* device).
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
2.1+, for a natural fluid current motor device with means for controlling a casing or other flow guiding means in response to natural fluid current force or direction.
7, for a natural fluid current motor device comprising a float supported or buoyant runner.
- 906 Having specific features for water current:**
This subclass is indented under subclass 905. Device comprising structure particularly adapted to a natural water current environment.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
3.1, for a pump* or motor* with means for controlling casing* or flow guiding means in response to natural fluid current force or direction which pump or motor has specific features for water current.
7, for a device comprising a float supported or buoyant runner.
- 907 Vertical runner axis:**
This subclass is indented under subclass 905. Device wherein the runner's* axis of rotation is generally parallel to the force of gravity acting on the working fluid*.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 4.2, for a rotary pump* or motor* with means for controlling casing* or flow guiding means in response to natural fluid current force, which pump or motor has a vertical runner axis.
- 4.4, for a rotary pump* or motor* with means for controlling casing* or flow guiding means in response to natural fluid current direction, which pump or motor has a vertical runner axis.

908 **Axial flow runner:**

This subclass is indented under subclass 905. Device wherein the working fluid* path to, through, and from the runner* is predominantly parallel to the runner's axis of rotation.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 4.3, for a rotary pump* or motor* with means for controlling casing* or flow guiding means in response to natural fluid current force, which pump or motor includes an axial flow runner.
- 4.5, for a rotary pump* or motor* with means for controlling casing* or flow guiding means in response to natural fluid current direction, which pump or motor includes an axial flow runner.

909 **AIR STACK OR SHAFT HAVING NATURAL FLUID CURRENT MOTOR:**

Rotary device comprising a pipe, cylinder, column, or other conduit through which the working fluid* is nonmechanically induced to flow. The working fluid flows through the pipe, cylinder, column, or other conduit to or from a natural body of air and the device obtains mechanical power from kinetic or potential energy associated with this flow (i.e., "motor"* device).

- (1) Note. The working fluid current is induced to flow by nonmechanical means such as by convection, by a naturally occurring pressure differential, etc.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 2.1+, for a natural fluid current motor device with means for controlling a

casing or other flow guiding means in response to natural fluid current force or direction.

- 905+, for a natural fluid current motor.

910 **REVERSIBLE BETWEEN PUMP AND MOTOR USE:**

Rotary device which is adapted for use alternately to add energy to a working fluid* (i.e., "pump"* device) or to obtain mechanical power from kinetic or potential energy in the working fluid (i.e., "motor"* device).

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 21+, for automatically controlled rotary devices many of which disclose similar convertibility.

911 **PUMP HAVING REVERSIBLE RUNNER ROTATION AND SEPARATE OUTLETS FOR OPPOSING DIRECTIONS OF ROTATION:**

Rotary device which adds energy to working fluid* (i.e., "pump"* device) and which comprises means to selectively rotate a runner* in one or an opposite direction. The device further comprises a working fluid exit means which operates exclusively when the runner is rotated in one direction, and a different working fluid exit means which operates exclusively when the runner is rotated in an opposite direction.

- (1) Note. This collection is not intended to include a device having a working fluid flow path which is merely reversed when the runner's direction of rotation is reversed.

912 **INTERCHANGEABLE PARTS TO VARY PUMPING CAPACITY OR SIZE OF PUMP:**

Rotary device which adds energy to working fluid* (i.e., "pump"* device) and comprises pieces intended to be exchanged with other pieces within or separate from the device to change (a) the maximum or minimum working fluid* flow which can be handled by the device or (b) working fluid pumping characteristics of the device.

913 INLET AND OUTLET WITH CONCENTRIC PORTIONS:

Rotary pump* or motor* device comprising working fluid* entrance and exit passages which (a) extend along a common axis and (b) are positioned one within another.

914 DEVICE TO CONTROL BOUNDARY LAYER:

Rotary pump* or motor* device comprising particular means to influence working fluid* immediately adjacent a surface along which the working fluid flows.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

115, for a device with a passage in a blade*, vane*, shaft*, or rotary distributor communicating with the working fluid, which device may include boundary layer control means.

915 PUMP OR PORTION THEREOF BY CASTING OR MOLDING:

Rotary device which adds energy to working fluid* (i.e., "pump"* device). The device comprises a part which is constructed by pouring material into a mold or hollow form.

916 PERPETUAL MOTION DEVICES:

Rotary pump* or motor* device which claims to operate in a closed environment without a sustaining energy source.

END